AD-784 061

REPORT OF THE ARMY MATERIEL ACQUISITION REVIEW COMMITTEE (AMARC). VOLUME II. COMMITTEE REPORTS

Wendell B. Sel

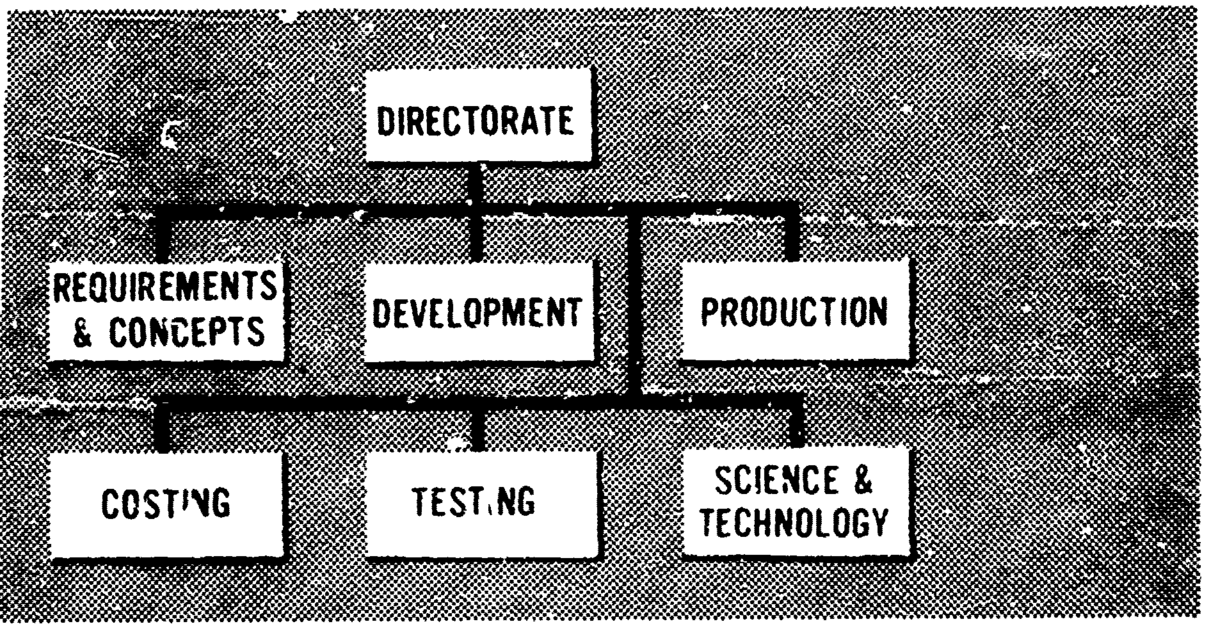
Office of the Secretary of the Army
Washington, D. C.

1 April 1974

REPORT OF THE

ARMY MATERIEL ACQUISITION REVIEW COMMITTEE

(AMARC)



VOLUME II

COMMITTEE REPORTS

1 APRIL 1974

DISCLAIMER

This report is the product of the Army Materiel Acquisition Review Committee (AMARC). The AMARC was an advisory committee from outside the Department of Defense. It was formed by the Secretary of the Army on an ad hoc basis to analyze the Army's materiel acquisition process and recommend improvements. Although some recommendations contained herein have been, or are being, implemented, the major ones currently are being reviewed by the Army Staff and major commands. Accordingly, this report remains advisory in nature. It reflects neither official policy nor approved plans of the Department of the Army.

TABLE OF CONTENTS

DEPARTMENT OF THE ARMY
WASHINGTON, D.C. 20310

DACS-XSA-ARC 1 APR 1974

MEMORANDUM FOR THE SECRETARY OF THE ARMY

SUBJECT: Transmittal of Report of AMARC Study

1. Reference: Memorandum, Under Secretary of the Army for Dr. Wendell B. Sell, dated 6 December 1973, subject: Army Materiel Acquisition Review Committee (AMARC).

2. I am pleased to submit herewith the report of the Army Materiel Acquisition Review Committee (AMARC). As requested, AMARC has sought out problems, including any causative elements fundamental to the Army and its acquisition process, and has recommended solutions. AMARC has also attempted to present a balanced view, identifying strengths as well as weaknesses.

3. Certain recommendations are appropriately qualified in recognition of the brevity of the study, the newness of the current Army acquisition system, and the less than complete treatment of "real world" considerations.

4. Each Committee member wants to express his appreciation to the members of the Army for their cooperation, candidness and hospitality in responding to AMARC inquiry. We also want to thank you, the Steering Group and the Advisory Panel, for your counsel and for opening the necessary doors.

5. We hope the Army finds the recommendations of the study clear and of assistance in improving the acquisition process which is so vital to the Army's combat function. If I or any member of AMARC can assist further in clarification of any issues or answering any questions, please do not hesitate to ask.

Wendell B Sell

1 Incl
as

Wendell B. Sell
Chairman, AMARC

FOREWORD

This volume contains the reports of the Director and each of the six AMARC teams. Based on visits, interviews, briefings, and professional experience, the teams have set down their observations, judgments, opinions, and recommendations for improving the Army's materiel acquisition process. The general thrust of the recommendation is on what should be done and not how it should be done. The team reports are intentionally brief--so they will be read; of necessity, they do not contain all the background upon which judgments were based.

COMMITTEE REPORTS

CHAPTER I

REQUIREMENTS AND CONCEPTS TEAM REPORT

A. INTRODUCTION.

1. As part of an overall review of the Army's materiel acquisition process, a Requirements and Concepts Team of the AMARC was established to review and evaluate the activities and procedures associated with the initiation of development or improvement of weapon systems during the Conceptual Phase. This phase is the most critical in the development process. Steps taken at this time to determine, express and justify the need for a new or improved capability have far reaching effects throughout the remainder of the acquisition process. This Team has adopted as its charter the question, "How should the Army conduct its affairs so that it makes intelligent decisions about the kind of equipment it intends to develop and acquire?"

2. How well is the Army materiel acquisition system functioning? This question is central to the entire AMARC effort. The institutional briefings given at the beginning by AMC and others were to the effect that there may have been minor problems but that things are being improved at a rapid rate. It is difficult though to dismiss the past when there are examples of poor experience in the acquisition of materiel. For example, of the four excellent rifles the Army has had in its distinguished history, three were forced upon an unwilling Ordnance Corps by the then President of the United States. Data from sources such as the Stratton Report (Sheridan/Shillelagh) and the various Congressional reports on the M16 Rifle not only provide a complete coverage of the problems involved but puts these problems into the contemporary time frame. Other examples can be cited—M73/219 Tank Machine Gun, AH 56 Helicopter, and XM 803 Tank. Our general conclusion is that the system is not working very well and has produced too much inferior equipment at high cost. This is particularly true in the areas of guns and mortars. Visits to laboratories and user organizations bear out this conclusion. The users seem greatly dissatisfied by the quality of the equipment and most of the laboratories seem to be doing little that is relevant to Army problems.

3. The next logical question is—are things getting better or worse? The system seems to be definitely improving in one particular area. The introduction of AR 1000-1 and its accompanying Letter of Instruction

has given the user much more influence in what equipment gets developed and bought. This is being reflected in reappraisals of many programs and delay or cancellation of some marginal efforts. For example, the Armored Reconnaissance Scout Vehicle program has delivered two prototypes, one resembling a miniature tank, the other a large jeep. The user organizations have halted the program for a year while they test these vehicles to determine what they really want. This and similar efforts are very good signs. The fact that the Army embarked on a major revision of its acquisition process in 1972 is testimony that it perceived a major problem. However, cancelling or delaying marginal programs does not put good equipment in the field. This leads to the premise that the efforts put into the front end of the R&D program—

a. To identify opportunities for new equipment,

b. To experiment with innovative ideas,

c. To assess (and give visibility to) technical risks of critical or sophisticated components,

d. To understand the doctrinal implications of what may result as a system,

will pay dividends out of all proportion to the R&D funds then committed. Conscientious implementation of AR 1000-1 (or any similar policy statements) will make it much less likely that poor or unsuitable equipment gets developed, acquired and put in the field. Although AR 1000-1 can stop bad equipment it does not necessarily provide the incentives and methods for acquiring good equipment. Improperly interpreted or inflexibly treated, it could stifle the fortuitous accidents which frequently produce outstanding equipment. Positive action must be taken to motivate the system (Army) to try new ideas by building and testing prototype equipment and involving the user in operational experiments.

4. When is a "materiel acquisition process" really a process? These three magic words, "materiel acquisition process," may contain the seeds of abuse decried loudly in the acquisition of materiel. What is connoted by "materiel acquisition process" is a step by step, inflexible march toward an ultimate goal—a gun, a helicopter, a tank. Such a phrase can be seized by elements in the bureaucracy to carve out their "territory" through which all must pass for their due challenge and approval enroute to success. We don't think that such is intended by

the Army but this is one of the traps that can be encountered in defining how the Army, or anyone for that matter, goes about acquiring materiel and navigates the tortuous routes in justifying and selling programs to OSD and the Congress. We recognize that the bureaucracy needs a framework within which to work, and that a roadmap is needed to assure that the integration of the many facets of an operational system is achieved, and as with any good roadmap the places to stop, rest, survey the conditions of the road ahead and review whether we still want to get to the destination, must be marked. The warning to the Army and its managers—don't let the structured process with its necessary detail create inflexible attitudes on how the Army approaches new ideas and acquires needed equipment.

5. The ensuing issues and related discussion will provide what we feel are necessary steps in assuring adequate front end considerations prior to embarking on a full blown engineering and production program.

B. ISSUES.

1. What should be the Army's materiel acquisition philosophy?

a. Discussion.

(1) The Army has formulated an impressive framework of policies and procedures to guide materiel acquisition; attention has been given to identifying the players (user, materiel developer, combat developer, etc.) and their role, definite streamlining has occurred in the documentation and administrative steps, the decision making process has improved, and commendable steps have been taken in decentralizing responsibilities and management of non-major systems. Still the nagging question is—"Will these policies and procedures provide economical, operationally effective equipment at the other end?" Our conclusion is that the answer is probably not favorable. The future could still provide an unacceptable level of uncomfortable stories of cost over-runs, unanticipated technical problems, over-abundance of optimistic promises and disturbing criticism from OSD and the Congress. The problem is more fundamental in that the Army's process attempts to fit all materiel development into a common mold and this restricts the needed freedom of technicians and managers. As a team we submit that the Army's materiel needs are satisfied generally through three approaches—

(a) Buying equipment already developed (commercial—domestic or foreign, other Services, or allies).

(b) Evolutionary improvement of current standard equipment.

(c) Developing a new class or type of equipment.

On the surface, this is not new but what is new is the emphasis that should be placed on a particular approach and the recognized strengths or weaknesses of the Army's corporate body in dealing with each approach.

(2) The first approach and, to some degree, the second are where the Army's current acquisition process is most appropriate and seems to work well. In these cases, the user can specify what his needs are and the developing agency can respond to this document by acquiring or developing the required equipment in a straightforward and expeditious fashion in accordance with established procedures. The Army's process is applicable for those evolutionary actions where the technology is well in hand, the user thoroughly understands what the improved equipment will do and the developer has adequate data on cost and schedule.

(3) The Army's process is poorly adapted to developing a new class or type of equipment (last approach). In this case, the user doesn't really know what he needs because he doesn't know which parameters are important in an operational sense and which are not. The developer is not really sure how long it will take or how much it will cost because it has not been done before. It is usually in this atmosphere—neither the user nor the developer knowing what should be done or how to do it—that the Army formalizes a "requirement" and a large program is started. The results are predictable and can be found in GAO reports, Congressional reports, the daily newspapers, and the acidulous remarks of SECDEF. The single most important message is, "Build it and try it <u>before</u> starting a large program."

(4) The Army should satisfy its materiel needs to the maximum extent from equipment already developed. There are numerous examples of the Army doing just this for the following types of equipment: communications, audio-visual, construction, and most notably the recent implementation of the Army's concept of replacing many of their tactical vehicles with commercial vehicles.

(5) The evolutionary improvement of equipment is certainly not new. There is a very active product improvement program underway in the Army but we believe that the Army would reap significant benefits from enunciating a policy that evolutionary (progressive) improvements to standard equipment will be the preferred method for acquiring developmental systems. Implicit in this suggestion is that the improvements will be "bite sized"; several complex, high risk components applied simultaneously would be a departure from this policy. This method has been used with a good deal of success in France and Russia. Circumstances such as availability of resources may have forced this on these countries but it seems that similar circumstances may be becoming more applicable here. Evolutionary improvements reduce the technology risks, simplify training and improve logistic support. Many of our problems found in acquiring a new system would certainly be mitigated through this approach.

(6) Developing the new class of equipment is the ultimate challenge. This is the new weapon or the application of new technology to our more familiar systems. It is this situation where the most doubts exist: Do we need it? Are we being sold a bill of goods? etc. We believe that it is this situation that the Army's acquisition system is poorly structured to handle and it is to this case that our suggestions are mainly directed.

(7) Equipment providing quantum jumps in capability or completely new capabilities comes from the recognition and adoption of new ideas, not from starting large programs in response to some ill defined, overly justified need. Establishing an Initial Operational Capability (IOC) date at the outset is really an invitation to disaster because the entire system is motivated to meet the milestones quite independent of whether the effort makes sense or not. It is also clear that well funded programs with a large constituency are very difficult to terminate even though they are patently in deep trouble. A small experimental effort aimed at trying out an idea can be stopped easily when it becomes obvious that the idea is flawed (and many are). We recommend strongly that the ROC, Task Force, ASARC, DSARC and establishment of a Program Manager be delayed until critical experiments have been performed, technology is demonstrably in hand and the user has had the opportunity to test the concept in an operational environment using experimental equipment which demonstrates all the salient points. Then, and only then, should engineering development (6.4) begin.

(8) It is not our intent to counsel avoiding the truly new "system"; rather the intent is to encourage it when needed and to show how it can be handled when it is a viable alternative. We are equally concerned that the structured process the Army (and the other Services as well) follows may actually stifle the process of taking advantage of opportunities and ideas because a part of the problem in handling innovative ideas is in recognizing the potential when presented.

(9) Can the Army compete for R&D and procurement funds by following the low profile approach? In the past (and recently too) the answer has probably been no. There is a perception the climate is changing and it would be appropriate for the Army to take a leading role. The truth after all may have the sharpest cutting edge. The truth about intentions, risks, and problems leads to credibility, and credibility leads to understanding and cooperation from OSD and the Congress. A case in point is the Air Force's Lightweight Fighter program. It is a program having high level interest, yet limited objectives. It is a program to test concepts, reduce reliance on theoretical studies, to lessen risk and uncertainty and to provide decision makers options for the future based on demonstrated hardware. The concept for this program may provide clues as to future possibilities for Army application.

b. Recommendations.

(1) That the Army enunciate a policy of evolutionary improvement of standard equipment as the preferred method for acquiring developmental systems.

(2) That high risk programs for new classes of equipment should be recognized as risky endeavors and—

(a) The Army should avoid "locking in" on the requirement (system description) too early.

(b) Experiments should be accomplished using early prototypes or jury rigged devices to ascertain or prove usefulness of the critical components.

(c) The early efforts (that may culminate in a system) should be kept in low profile, involve modest funds, avoid high-level management commitments/promises about system expectations. Gain assurance that the technology is in hand and risks reduced and/or known.

2. How should the Army embark on the development of a materiel system?

a. Discussion.

(1) The Army initiates programs leading to development of a system through approval of a Required Operational Capability (ROC). Due to the frequent changes (Apr 71 and Aug 72) in the documentation supporting the Army's acquisition process there are a variety of documents currently serving as approved requirements documents in addition to the ROC, e.g., Qualitative Materiel Requirement (QMR) and Materiel Need (Engineering Development) (MN(ED)). No matter what name or format has been used, the document serves as the "user" statement of his need for a system.

(2) The theory is that the user can specify what his needs are and the developing agency can respond to this document by developing the required equipment in a straightforward and expeditious fashion in accordance with approved procedures. As discussed in the preceding issue, we believe that this concept is workable for acquisition of already developed equipment or improvement actions to standard equipment where the technology is well in hand, the user thoroughly understands what the improved equipment will do and the developer has adequate data on cost and schedule. The concept is unworkable when a new class or type of equipment is to be developed and acquired.

(3) The discussion hereafter is intended to address generally the development of the new class or type of equipment and, to the extent that the improvements to standard equipment involve complex, sophisticated change, that group also. In the opinion of our team, historically the most successful developments or the most useful operational equipments have not resulted from the "requirements" process, while building and trying equipment in response to a good idea has a much higher batting average—particularly if normalized to resources expended. Significant examples can be cited where the establishment actively resisted the introduction of a materiel system (Jeep, Christie Tank, P-51 Fighter Aircraft, SIDEWINDER and the previously mentioned US Army rifles). Very bad ideas can also get inflicted on the acquisition system by forceful personalities, but on balance we believe there is a lesson to be learned. Structure the process to accomodate both the ideas from inside and outside the establishment and do not depend on the committee approach for direction.

(4) It is necessary to motivate the system to generate and accept new ideas, to respond to these ideas, to try them and to produce and thoroughly test new equipment before embarking on full scale development efforts. A mechanism is needed that will appeal to the basic instincts of success, recognition and pride, and recognize the fact (not problem) that, in Civil Service and the military, people can't be either demoted, promoted or fired without great difficulty. This latter point should not be a detriment because the basic salary and benefit structure, both Civil Service and Army, is such that competent people can be attracted and held if the work is satisfying. Our proposal is to involve the user in the sponsorship of projects within the R&D program. The matrix (Figure I-1) shown is an attempt to do this without massive reorganizations or policy changes.

	MANAGING AGENCY		
BUDGET CATEGORY	AMC	BOTH	TRADOC
6.1	100%		
6.2	80%		20%
6.3A	50%		50%
6.3B	25%	50%	25%
6.4		100%	
PEMA		100%	

ROC, ASARC, DSARC, Task Force, etc.

NOTIONAL SCHEME FOR SHARING SPONSORSHIP OF PROGRAMS

Figure I-1

The column heading "AMC" is meant to represent the developing community and the column heading "TRADOC" is meant to represent the user. We believe that AMC and TRADOC are the correct levels to represent these interests and that the negotiations and decisions should not take place in the DA Staff. The objectives of this matrix are—

(a) To encourage greatly increased communication between the user and the developer.

(b) To motivate the user to become much better informed about the R&D process so that his share of the money will be spent wisely.

(c) To motivate the developer, particularly the laboratories, to actively pursue potentially attractive new ideas and to sell to the user the procedure of building and testing of equipment to evaluate some of these ideas.

(d) To provide a process by which good ideas from industry and other sources, such as foreign equipment, can get into the system.

(e) To provide a non-rigid structure which will encourage building prototype hardware and conducting the critical experiments before engineering development is begun.

(5) Several points need to be made with respect to the concept:

(a) The user will not let contracts or start his own laboratories to undertake research and development work. The developer has the action in these cases.

(b) The formal procedure—ROCs, Task Forces, ASARCs, DSARCs, Program Management Offices and the like—do not start until the critical experiments are done, the technology is in hand, costs are understood and the user fully understands what he is going to do with the equipment. This formal process occurs between the 6.3 demonstration and the 6.4 engineering development activity.

(c) To the extent this departs from traditional involvement in the R&D program, resistance to this idea can be expected. The developer loses a measure of his autonomy and the user acquires a large new responsibility. Further, the user will henceforth have only himself to blame if he gets poor equipment. It is also recognized that administrative problems of putting together an R&D program that marries the activities of two commands will exist, but if the approach will introduce new insights into and improve our R&D effort, then the solutions to such problems will be worth the effort.

(6) What has been described applies to the initiation of work falling in the R&D categories 6.2, 6.3A and 6.3B. It addresses

the coupling of the interests of the developer and the user to assure direction to the R&D program and a strategem to take complex ideas or risky ventures through those early formative stages where failure or successive iterations are more the rule than the exception. When we are ready to proceed to the Full Scale Development Phase (6.4) is the time to establish what the Army now refers to as a "firm requirement."

(7) The diligent reader will have observed that we place great reliance on the in-house laboratories in generating and demonstrating new ideas. Having an "in-house" view we are painfully aware that the incentives to the laboratories are to not "rock the boat" or otherwise exacerbate the situation. We believe that the only way that the laboratories are going to produce is by the (possibly painful) application of the competitive pressures. What must be recognized is that all of the present pressures at all levels are to maintain mediocrity. Once we break this problem we should expect rapid improvement.

(8) A fundamental truth is that comparative tests are the only judge. We must test our new ideas and equipment in the presence of what is available now or what could be accomplished by others. This may frequently be painful. As noted above, the major pressures to make the "in-house" system produce are those of competition. The threats of demotion and firing are largely ineffective. The affront to pride of having another system adopted is very real.

(9) We believe that the laboratories should be put in a position of competition as often as possible in order to evaluate new concepts and equipment. Example: Artillery—Suppose that we believe that the Soviet 130mm will shoot further than our 155mm and that we need a new howitzer. The CG of the Artillery School should be nominated as the head gunner and should state what he believes to be the deficiencies. ARMCOM and the Naval Weapons Laboratory, Dahlgren, should each be given a purse and told to bring the best effort they could to the proving ground two years hence. They should be told what the test plan is and that we are also going to have a Soviet 130mm on hand. This experiment is probably well worth doing and should result in an improved weapon.

(10) We are solidly in favor of competitive prototyping, both for ideas, concepts and experimental equipment, as well as during engineering development.

(11) The professional military officer has been thoroughly trained to try to bring order out of chaos. The R&D process is by nature disorderly and attempts to regularize and institutionalize it will usually stifle it. We are in hopes that the suggestions given will bring some order without repressing the process.

b. Recommendations.

(1) R&D effort in the 6.2, 6.3A and 6.3B categories should be accomplished with low-level programs, full realization of technical risks, and no management promises.

(2) Developer should build it and try it and let the user try it and see if he likes it.

(3) Emphasize and guarantee continued dialogue between materiel developer and user. Adopt the concept of shared sponsorship of the R&D program as described in the national matrix.

(4) Introduce a large measure of competition into the in-house laboratory way of doing business in an effort to make them more productive in fielding useful and effective equipment.

3. How should Requirements be established?

a. Discussion.

(1) The preceding issue concluded that the firm requirement should not occur until entry into the Full Scale Development Phase (6.4). At that time the Army should know what it wants, can describe the technical risks (if any remain), and can defend a full program.

(2) Our team believes that in one sense there is no such thing as a "requirement." The concept that a description of the end product can be made at the front end of a development program may be responsible for more useless and expensive equipment being acquired than all other causes combined. We believe that the user cannot specify what he needs within the very real constraints of cost, technical risk, and maintainability. The user can usually specify what he wants but this frequently leads to disastrous delays and over-runs. In this climate, the developer can, and frequently does, begin development of some item of equipment because it represents a technological challenge but does not necessarily provide a useful military capability. Therefore,

the Army should recognize and accept this fact, then structure a process to allow for it. If the word "requirement" causes managers to loose sight of the objective of providing operationally useful equipment to the Army, then it should be dropped from the Army's lexicon. The Army has recognized the importance and long term effect of "approved requirements." Both TRADOC and HQDA subject proposed ROCs to rigorous screenings with the result that over the past year (1973) approximately 50% of ROCs submitted to HQDA have been disapproved. A determined effort has also been made to terminate previously approved requirements documents that no longer represent or describe valid Army needs or that were never funded for development. For 1972 and 1973 over 200 "requirements" documents were terminated. This achievement is more meaningful when compared with the current list (as of 1 Jan 74) of approved documents which now consists of 294 documents.

(3) The user's inability to describe his needs is no condemnation. He has learning curves also, but his learning experience supports, depends on and intersects with the materiel developers' learning experiences; therefore, the roles of these two agencies must be mututally supporting. The sharing of sponsorship of the R&D program as has been described is a reflection of this thought.

(4) If documentation (ROC) of a specific system does not occur until the Full Scale Development Phase, then how is user guidance provided during that critical advanced development stage when the embryonic system takes form? We propose there be a user (usually TRADOC) document that would provide user perception as to what would constitute a useful system for the Army. This might be expressed from the standpoint of deficiencies noted in existing systems, limitations because of the soldier (weight, complexity) or doctrine, capabilities vis-a-vis the threat, or opportunities for marked improvements. This document would be a logical extension of the very general Operational Capability Objectives (OCO). It could have the nucleus of the format of the ROC but this might be too tempting and the potential too great for embarking on "designing" the system. It would be most useful for AMC and TRADOC to jointly explore the intent and purpose of the document and propose a format if one can be conceived to cover all situations.

(5) How would this early guidance document be used? First and foremost this will be a TRADOC/AMC document and not approved by HQDA per se. This document would be a supporting exhibit to the specific project within the overall R&D program which is submitted to HQDA. By this device it would receive the HQDA exposure in the context of a

planned R&D project and would provide the type of information that HQDA, the Secretariat, OSD and the Congress would expect from the user. Approval (or allocation of funds) of the project is tantamount to agreement with the user description presented in the exhibit.

(6) Problems? Yes, there would be problems. To follow this path would require—

(a) Common perception of the Army's deficiencies and availability of broad HQDA guidance to TRADOC and AMC concerning those deficiencies.

(b) A faith that TRADOC and AMC have the best interests of the Army in mind and a feeling of responsibility to field excellent equipment.

(c) Close ties between TRADOC and AMC and mutual respect and need for each other.

(7) With this prelude we believe that after completion of advanced development a ROC can reasonably be prepared that would describe the needed equipment, how it can be used, a reasonable time frame for acquiring it, and an accurate cost.

b. Recommendations.

(1) That the concept of a user document be accepted to guide system advanced development (6.3B) and used in connection with Planning, Programming and Budgeting System (PPBS).

(2) That the ROC be prepared after successful completion of advanced development.

4. Who should perform the "USER" role in the acquisition process?

a. Discussion.

(1) It is obvious that the true user of equipment, the organizations that will use materiel in anger, should be the ones to determine their requirements and state their needs, that is IF they are qualified to do so. The actual user of the materiel, the operational commands, do not have an immediate interest in or a framework in which to consider equipment that may be delivered to them 5-10 years from now. Their highest priority is given to materiel readiness and training with materiel on hand or to be delivered in the near time frame. Commanders in

the field are graded on their ability to perform with currently available equipment. It is therefore not desirable to place this responsibility of being the "user" for future equipment on the actual user of current materiel. There are exceptions to this general statement for operational commands such as Army Security Agency (ASA), which has a combat developments role in addition to its operational role and, therefore, can logically fulfill a "user" role for future equipment related to its primary mission.

(2) Who then should be the representative of the "user?" Who is the best qualified in this capacity and can take on the responsibility without additional staff for this purpose? We believe that TRADOC is the logical agency to be assigned this responsibility for the following reasons:

(a) Although TRADOC does not utilize the equipment in an operational situation, they develop how it should be used, with what forces and prepare the doctrinal manuals.

(b) The soldiers (combat and support) are instructed by TRADOC Schools.

(c) In preparing and teaching future doctrine, TRADOC and their subordinate commands are the logical agencies to determine the need for new materiel.

(d) Because of their organization and mission, TRADOC has the staff available with the expertise and a user oriented point of view qualified to act as the user's representative.

(e) Finally, TRADOC willingly accepts this responsibility as a logical extension of their functions and, at HQDA direction, is now designated as "user representative" for most equipment being acquired.

(3) If the TRADOC Commander is given this responsibility to represent the user, he must also be given the wherewithall to fulfill this responsibility, and to this end we have recommended his voice in the sponsorship of R&D projects. Historically in the Army, the materiel developer has had the greatest influence in the acquisition of equipment, while in the Navy and the Air Force the "user" had the most influence. Neither has worked well. It is our intent to achieve a balance between the "user" and the "developer" points of view, in this sense TRADOC and AMC, in acquiring equipment responsive to the

needs of the Army. In this way we intend to see that the user will stop the procurement of undesired or not required materiel, and the developer will force the user to back off on his unreasonable "requirements" if he expects to get usable materiel in the reasonable future.

(4) It is our further belief that the user must be involved in testing the equipment through prototypes and hardware models and to assure the equipment is what the Army needs before large programs involving many dollars are sunk into engineering development and before it is too late to prevent production failures.

(5) In fulfilling this user representative function, TRADOC must have rapport with and effective communications to the operational commands deployed worldwide in order that there will be an effective exchange of ideas within the user community. Operational commands, such as FORSCOM, should be involved by TRADOC in participating or conducting operational feasibility tests and field experiments assessing doctrine and organizational concepts.

b. Recommendations.

(1) CG, TRADOC should be designated by policy as the "user representative" for most equipment being procured by the Army, with authority to delegate this responsibility only to his subordinate commands.

(2) Exceptions to this policy should be made only when another command has the capability (resources) and proper vantage point to address the Army's equipment needs in the future.

5. Cost Operational Effectiveness Analyses (COEA). The COEA done for the major Army projects are of spotty quality and in some cases non-existent. What should be done?

a. Discussion.

(1) The Army, through its current policies and procedures for materiel acquisition, requires preparation of COEA for all systems being acquired, updating of COEA as decision milestones are approached, and, through a recently established program, an effort to prepare missing COEA on systems that were started prior to the publication of AR 1000-1. During interview with several key Army managers it became apparent that great dependence was being placed on COEA to assist them in making

decisions between alternatives. One of the essential products of the Special Task Force is the preparation of the Concept Formulation Package (CFP) of which the COEA is the key part. It is obvious that the Army sees a need for and is giving visibility to cost and operational effectiveness considerations. We concur with this in principle but sound this tocsin—the Army may be developing a preoccupation with COEA. To the extent that the requirement for this work makes general officers and other decision makers better informed on cost, performance and serviceability of equipment, motivates them to demand new data, question old data and precepts, and occasionally to become outraged, it can be immensely valuable. When, however, someone depends too much on poorly known cost and equally unknown indications of effectiveness, the whole process becomes a dangerous liability in making a decision. The fundamental problem is that studies can be (and have been) wickered to show that the new and complex equipment is better. This is called the "Silver Bullet Syndrome" in the trade. Example: Postulate a $1 million tank that is 20% more effective than a $500k tank. After all, a $1 million anything ought to be at least 20% better than a $500k anything. Do a ten-year cost run-out, accepting claims by developer of $1 million item that it will not require additional logistic support. Result is that the $1 million tank is always a better buy, until, of course, one gets into battle and needs lots of reliable and maintainable tanks. This "silver bullet" analysis has been particularly effective in the case of missiles, airplanes and helicopters. A World War II fighter took a total of 10 man-years of labor to produce. (Incidentally, so did a tank.) The newest generation of fighters take 1000 man-years to produce.

(2) Can COEA be used to justify the choice of new equipment? They can be used in this manner if models can be found or conditions set in the model to emphasize the desired differences. Conclusions can also be distorted in presenting results. The question is how can such fudging of results and prejudiced application be exposed or avoided. Prejudicial application can take place because there are many similar models and each has institutional biases incorporated in it. That is, the design of the model puts emphasis on the characteristics of the systems to be examined that the organization thinks are important. If other characteristics are thought to be unimportant, they may be neglected. In addition, development of models is expensive. The insertion of a digital terrain data package requires the reading, punching and verification of thousands of data items. Finally, models which don't discriminate among candidates are unpopular with analysts even when the knowledge that the candidates are of roughly even effectiveness

is far more useful than knowledge about small differences. Increased control can be gotten if we control the proliferation of models, invest effort in making the survivors useful, and ensure that the data used to feed the model are at least consistent, representative of the real world spectrum and hopefully based on an actual operational test. We believe this control needs to be at TRADOC level to ensure consistency in approach and cooperation of TRADOC and its agencies in designing the program for adoption of specific models and to provide overall directions for improving and obtaining of the required data.

(3) COEA should be a useful tool in helping the user describe the characteristics that he thinks are important, by forcing him to think through the design of the situation being modeled. It also should expose the sensitivity of the situations' results to the variables entered into the model. No substitute is available for good sense in selecting the parameters to be modeled or varied. But to be useful, the decision maker needs to know not only the results, but the limitations of the models and the aspects of the system that were not tested. The availability and visibility of the parameters, assumptions, and scenario serves to develop a baseline of knowledge. Then, if conclusions are challenged, a basis for rational and logical discussion is available. In this vein, the COEA supports military judgement; it does not replace it. Relating the COEA as a tool for the user, it follows that TRADOC should be responsible for all COEA not prepared under other auspices, such as the Special Task Force. TRADOC should develop the internal structure and procedures to assure high quality and defensible COEA, particularly since most COEA concern non-major systems, the management of which have been decentralized below HQDA level. Control and improvement of the process must be the responsibility of a single agency at TRADOC level. Control can be established through the publication of rules for the conduct and presentation of COEA. Improvement can be made through the development, cataloguing, and improvement of models and through the establishment of a data bank for model input based on test insofar as possible.

b. Recommendations.

(1) Consider cost-effectiveness analysis of each system a constant companion during the development process. Insure that COEA are used to ventilate the issues thoroughly and to inform as many people as possible to as great a depth as possible. Then insist that decisions be made by responsible, informed, professional soldiers using COEA as only one of many factors.

(2) Simplify COEA so that users understand implications of numbers as they are manipulated by systems analysts. To this end, require each COEA to clearly identify the following:

(a) RE - relative effectiveness of new item versus item replaced.

(b) RC - relative cost of new item versus item replaced.

(c) RW - relative worth of new item in terms of how much more fighting effectiveness it provides for a given expenditure than would continuation of the old system for the same expenditure.

(3) Assign TRADOC responsibility for preparation of COEA (except for those prepared by Special Task Force or otherwise assigned to other agencies for special reasons) and constitute a special board to review each COEA in detail and comment on them to CG, TRADOC. Board members should include TRADOC Center Commanders, and they should be supported by an independent staff.

6. What should be the role of OSD in the R&D process?

a. Discussion.

(1) There are adequate data available to support the contention that the Services do not do materiel acquisition particularly well or economically. There are no data to show that the OSD (DDR&E and PA&E) makes this acquisition process better or worse. There have been instances where DDR&E supported high technology solutions to simple problems and made matters worse. There are also cases, such as DDR&E's strong support of the YF16/17 program, where they seem to be on the side of the angels.

(2) It appears that the Service R&D staffs are usually in an adversary position with their opposite numbers in the OSD. It is not clear that this is useful. Our team believes that the OSD should define mission areas and general levels of funding and adjudicate inter-service disputes if this is necessary. The OSD (DDR&E) should definitely not do line item management in the 6.2 and 6.3 areas but should instead remain out of projects until the Services believe they are ready for engineering development.

(3) It is gratefully recognized that DDR&E has been the defender and supporter of 6.1, 6.2 and 6.3 budgets for some years. Left to themselves the Services would probably have greatly reduced these budgets and put them into 6.4 or PEMA and would have long since bankrupted the technology bank.

(4) It might be useful to provide DDR&E with a modest discretionary fund specifically designated to be spent at or by the Service laboratories (not DARPA). This would put DDR&E in the position of being <u>for</u> things rather than against them and the funding would make them welcome (and unusual) visitors to the laboratories. It would also provide another channel through which new ideas could get recognized and supported.

b. <u>Recommendations.</u>

(1) OSD should re-evaluate its role in materiel acquisition to develop policies and procedures allowing the Services to pursue materiel development within OSD defined mission areas and general levels of funding. Line item attention to R&D projects would not begin until start of engineering development.

(2) OSD (DDR&E) should maintain a modest discretionary fund with which OSD could have the Services pursue particular projects or embark on new initiatives in research and development.

(3) ASA (R&D) should have a similar fund for the same reasons.

REQUIREMENTS AND CONCEPTS
ANNEX A

INTERVIEW	REPRESENTING	DATE
LTG J. G. Kalergis	Asst. Vice Chief of Staff	21 Jan 74
MG P. Powers	Former Dir. Pershing II Task Force	23 Jan 74
LTG J. J. Hennessey	Chief of Reserve Components	1 Feb 74
MG D. A. Starry	CG, Armor Center	12 Feb 74
Mr. W. A. Chavet	Office of Comptroller	13 Feb 74
Mr. R. J. Trainor	Dir. Materiel Programs Directorate, Office Chief of Staff	13 Feb 74
BG E. Hirsch	Dir. Air Defense Office, Asst. Chief of Staff Force Development	13 Feb 74
MG J. H. Cushman	CG, Combined Arms Center	14 Feb 74
GEN W. E. DePuy	CG, Training & Doctrine Command	15 Feb 74
MG R. C. McAlister	Dep CG, Training & Doctrine Command for Combat Developments	15 Feb 74
LTG E. H. Almquist	Asst. Chief of Staff for Force Development	26 Feb 74
MG W. A. Burke	Dep. Asst. Chief of Staff for Force Development	26 Feb 74 26 Mar 74
Mr. A. Golub	Scientific Advisor for Asst. Chief of Staff for Force Development	27 Feb 74 26 Mar 74
Dr. W.B. McLean	Dir. of Naval Undersea Center, San Diego, CA	13 Mar 74

BRIEFINGS	SUBJECT	DATE
BG K. E. Dohleman Office Asst. Chief of Staff for Force Development	Role of ACSFOR in Requirements Generation and Concept Formulation	31 Jan 74
MAJ P. Hillier Office Asst. Vice Chief of Staff	Extended Planning Annex (EPA)	31 Jan 74
COL L. House Office Asst. Chief of Staff for Force Development	Materiel Procurement Priorities Review Committee	31 Jan 74

MG H. E. Hallgren CG, Concepts Analysis Agency	Role of the Concepts Analysis Agency	31 Jan 74

VISITS	DATES
Electronics Command, Ft. Monmouth, NJ	24 Jan 74
Armor Center, Ft. Knox, KY	12 Feb 74
Combined Arms Center, Ft. Leavenworth, KA	14 Feb 74
Training & Doctrine Command, Ft. Monroe, VA	15 Feb 74

CHAPTER II
DEVELOPMENT TEAM REPORT

A. INTRODUCTION

1. The Army weapon system acquisition process provided the framework for the Army Materiel Acquisition Review Committee (AMARC) team organization and mission assignment. (Figure II-1)

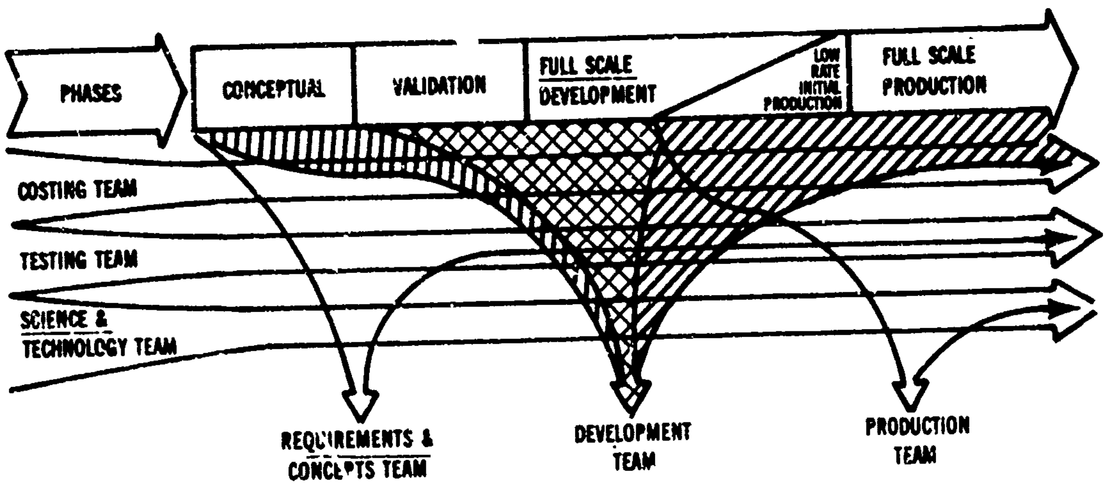


Figure II-1

The Development Team examined the Army weapon system acquisition process from the validation phase through development. The examination also included parts of the conceptual and production/deployment phases which affect proper execution of development activities. The results of the review of these latter areas were coordinated with the appropriate AMARC teams.

2. We looked at the Department of Defense and Department of the Army organizations, missions, functions, policies and procedures to determine the range of their impact on acquisition management. The

role and effectiveness of the Army project manager and his selection, training, qualification and motivation were included.

3. Many factors influence the weapons acquisition process. Some are obvious, such as political and technical. Others are less apparent. For example, the recognition of urgencies, establishment of priorities and the release of funding during periods of conflict vary greatly from those in times of detente. Threat and urgent need usually drive weapons development in times of high tension. Costs, relative national priorities and conflicting public opinions are more discernible, and strongly impact weapons acquisition during detente.

4. As national tension increases, layers of review, analytical studies and paperwork processing times decrease or go away. When the period of conflict ends, the layers of review increase, acquisition cycles lengthen and many redirections take place.

5. The magnitude of the assignment and the shortness of time associated with the study dictated that we focus on major areas of concern, a detailed analysis of these concerns and recommendations to provide early resolution to problems.

6. To accomplish the above, it was necessary to evaluate the concerns expressed by the Secretary of Defense and others. It was also necessary to analyze weapon system case studies and make an in-depth examination of previous reports on systems acquisition.[1]

---

[1] There are a number of substantive reports on systems acquisition. The Team examined six of these reports:

"Report to the President and the Secretary of Defense on the Department of Defense", The Blue Ribbon Defense Panel, 1 July 1970.

"Defense Acquisition Study", National Security Industrial Assoc., 1 July 1970.

"House Committee on Government Operations", H. Rept. 91-1719, 91st Congress, 2nd Session, December 1970

The Commission on Government Procurement, December 1972.

"Defense Science Board", Report of Task Force on Reducing Costs of Defense Systems Acquisition"; 15 March 1973.

7. As the study effort progressed, it became apparent that most of the concerns were not new - that most had been addressed, and, to some degree, corrected. Some areas of major concern remain and are addressed as outlined below.

ORGANIZATION

Commodity Orientation of the Army Materiel Command

Layering, Rigidity: Policy/Procedure

MISSION

Mission Deficiency

User Designation and Participation

CAPABILITY

Project Management

Civilian Personnel Administration

Further investigation of these areas was accomplished through briefings, visits, and interviews. (Annex II-A)

B. ORGANIZATION.

1. Commodity Orientation of the Army Materiel Command (AMC).

a. AMC has two basic missions; systems acquisition and readiness. The Army considers AMC's most important mission to be readiness; however, the capability of future forces is dependent upon todays acqusition of new systems. This area of major concern addresses the degree of management given the readiness mission which, if overemphasized, could adversely impact the acquisition mission. We examined the AMC Headquarters and commodity commands to determine if it is necessary to separate the two missions, and if so, at what level.

---

[1] "Defense Science Board", Report of Task Force on Reducing Costs of Defense Systems Acquisition"; 15 March 1973.

b. With regard to the headquarters, several studies have been accomplished in the past to determine its adequacy to manage both missions.

(1) AMC was organized in 1962 from the technical services. The Hoelscher Committee Report (Project 80)[2] originally proposed two major field commands under the Department of the Army Staff; one for acquisition and one for readiness. This initial proposal was changed during evaluation and further study. The desire to retain total system life cycle management in one command; and political, economic, and social considerations negated any move to organize into two separate commands or to reduce the number of subordinate commands.

(2) AMC was created with a Supply and Maintenance Command (SMC) established as a major element under the Commanding General, AMC. This command arrangement did not work very well. Commodity Commanders, in effect, had two command lines; one to the CG, AMC for systems acquisition matters, and the other to the CG, SMC for readiness matters. In 1966, SMC was fully absorbed into AMC's functional management.

(3) The Special Review Panel on Department of the Army Reorganization (Parker Panel)[3] seriously considered the division of AMC into two separate commands: one for acquisition and one for readiness. Their findings suggested that AMC was already studying internal consolidations to a greater depth than the Parker Panel could accomplish.

(4) In 1969, AMC headquarters evolved into a Deputy Commanding General concept with a Deputy Commanding General for Materiel Acquisition (DCGMA) and a Deputy Commanding General for

---

[2] "Reorganization of the Army 1962", Martin Blumenson, OCMH Monograph No 37M, pages 49-80.
[3] Chapter 14, Vol II, "Report of the Special Review Panel on Department of the Army Organization", 1 March 1971.

Logistics Support (DCGLS); both reporting to the CG, AMC. The DCGs coordinate and approve formal acquisition and readiness actions flowing upward through AMC. We believe that AMC headquarters is the logical level to manage both missions.

c. Turning to the commodity commands, AMC, in 1970, realigned the commands to further improve their management of weapons acquisition and readiness. Each command, structured along standard lines, has four major directorates; Research, Development and Engineering; Procurement and Production; Materiel Management, and Maintenance. The first two directorates generally are oriented toward weapon systems acquisition but depend upon field usage data, maintenance engineering and production engineering to insure adequate integrated logistic support and produceability of new systems. The latter two address weapon system readiness, but must receive development, engineering and procurement assistance for their adequacy of performance. We visited the commodity commands and the results are provided below.

(1) The Army Avaiation Systems Command (AVSCOM) and the Army Missile Command (MICOM).have their readiness mission aligned, where possible, on a weapon system basis and their acquisition mission is similarly structured. For AVSCOM and MICOM, the two missions work in harmony, appear compatible, and seem mutually beneficial. Although strong in engineering, AVSCOM's in-house research and development is weak. Their capability is more than adequate, however, through the use of National Aeronautics and Space Administration facilities in 6.1 and 6.2 R&D programs, and Edwards Air Force Base (Aviation Systems Test Activity) for the conduct of dependent developmental testing. They are initiating plans to strengthen their R&D.

(2) The Electronics Command (ECOM) materiel acquisition mission is being revised. The proposed changes look good and if successful, ECOM may prove capable of performing well in systems acquisition in spite of the heavy readiness mission demanded at that command. ECOM has experienced difficulties through staff interference with reorganization proposals and will need some command assistance in obtaining approvals for its reorganization. Further, more

real cooperation, in the form of meaningful support, must be given by the laboratory director to the project manager.

(3) The Armament Command is ably structured to perform product improvement and readiness. We observed several excellent examples of their ability to provide improvements to weapons systems through new components. Impressive also was their ability to quickly analyze user problems by teams in the field and by laboratory simulation. Available are examples of excellent operations which demonstrate close working relationships among laboratory technicians, engineers, and ARMCOM field technicians. ARMCOM is attempting to place some emphasis on better planning in the basic research and exploratory development area. However, the production, product improvement, in-house maintenance and materiel management functions seem to absorb the major efforts at the detriment of new item development.

(4) Because of the recent Weapons Command (WECOM) - Munitions Command (MUCOM) merger that resulted in the establishment of ARMCOM, seven arsenals[4] appear in the structure. We examined the organizational structure of ARMCOM (Annex II-B), its laboratories and arsenals, and found excessive layers of supervision between divisions in the arsenal and the Commanding General, ARMCOM. The total ARMCOM structure should be examined in-depth by AMC, further consolidated, and structured for new systems acquisition. This action should save personnel spaces and ARMCOM should improve management of both the acquisition and readiness mission.

4

Edgewood Arsenal - Chemical Laboratory; Biomedical Laboratory
Picatinny Arsenal - Feltman Research Laboratory
Rock Island Arsenal - Thomas J. Rodman Laboratory
Watervliet Arsenal - Benet Weapons Laboratory
Frankford Arsenal - Pittman-Dunn Laboratory
Pine Bluff Arsenal
Rocky Mountain Arsenal

(5) The Tank-Automatic Command (TACOM) appeared to have very little total weapon systems research and development capability. Most of their efforts are directed toward the readiness mission. The current CG and Director RD&E are moving in the direction of improving their research and development capability.

(6) We did not visit the Troop Support Command (TROSCOM) but we did visit the Mobility Equipment Research and Development Center (MERDC), a part of TROSCOM. They appear to have a total RD&E capability with primary emphasis on engineering in support of technical data packages for competitive production procurement.

(7) Each command works with a different industrial base and each industry does business differently. Some commands buy the majority of the items commercially, while some proceed through a formal development process with industry. Each commodity command should be organized commensurate with its unique problems and the industrial base with which it interfaces. The st ucture of each, by necessity, will be different.

d. Looking at the total AMC structure, past reorganizations have consolidated commands, installations, and activities. These reorganizations were an attempt to improve management at both the headquarters and subordinate levels of the command and at the same time save resources. These actions reduced the AMC installations and activities by 26% and the personnel by 31%.[5]

e. Summary of findings.

(1) Headquarters AMC is the appropriate level to manage both the acquisition and readiness missions.

---

[5] AMC Command Briefing, "Evolution of AMC Since 1962", presented by COL John Brennan, Dir., Plan and Analysis, AMC, 14 March 1974 to AMARC.

(2) AVSCOM and MICOM are organized on a systems basis and seem to adequately manage both the missions of acquisition and readiness. All other commands are moving to consolidate facilities and improve the acquisition process. However, the heavy emphasis on readiness within these commands and the standard organization of the commands have a negative impact upon the accomplishment of the acquisition mission.

(3) The ARMCOM organization has excessive layers of supervision.

(4) AMC commodity commands are competent in their execution of product improvement and solutions to fielded weapons problems.

(5) AMC has made significant progress since 1967 in reorganizing to reduce fragmentation and layering and cut manpower by 31%.

f. Recommendations

(1) Evolve toward separating management of new weapons and major product improvement acquisition from the minor product improvement and logistics aspects of fielded systems. The CG, AMC should accomplish this action as a primary goal and should separate the missions at whatever level he deems appropriate. The organization for the development of new systems and major product improvement should be determined by its weapons systems responsibility and the private industrial base with which it interfaces.

(2) Recognize and eliminate excessive layers of supervision within ARMCOM.

2. Layering, Rigidity: Policy/Procedures

a. The normal problems confronting AMC are further aggravated by unnecessary layering and fragmentation of authority at high levels. Although the numbers of people at each level have been reduced (Figure II-2), the layering still exists. (Annex II-B).

USD, OSA, DA STAFF STRENGTHS

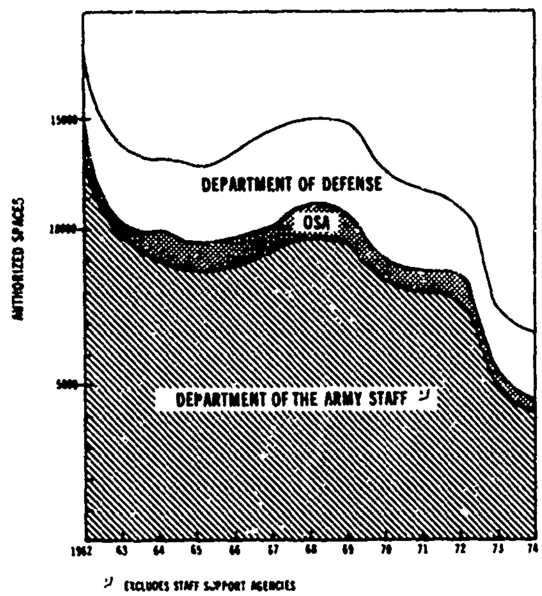


Figure II-2

The organizational layering itself should not necessarily contribute to delay in decisions or to overmanagement. However, if each layer individually reviews and assesses each decision on individual systems, the procedures become rigid and the process becomes fragmented. We found evidence of unnecessary layering and fragmentation as discussed below.

(1) The approval process as now structured is not only a problem of proceeding up three or four layers but also of **traversing** each layer to obtain individual staff element concurrence.[6] The time and sequence required to obtain approvals through the layering is demonstrated by the coversheet action for the Advanced Attack Helicopter (AAH) Development Concept Paper (DCP). This action (Figure II-3) also demonstrates the layering at each agency within each level in addition to the layering from level to level. Note the number of sub-levels within the Office of the Chief of Research and Development (OCRD) that were required to review the action; the results of which will fall within the approved thresholds for the system.

[6] This is further complicated by the budget process where each individual budget appropriation is handled through a separate staff "stovepipe" from bottom to top. Since an Army project manager will deal with all these appropriations during the life of the system he manages, he will have to make certain that his request in each "stovepipe" is sufficient to keep his program balanced and on schedule. He must rely on each layer to insure integration and adequacy of his total budget needs.

AAH COVER SHEET STAFFING

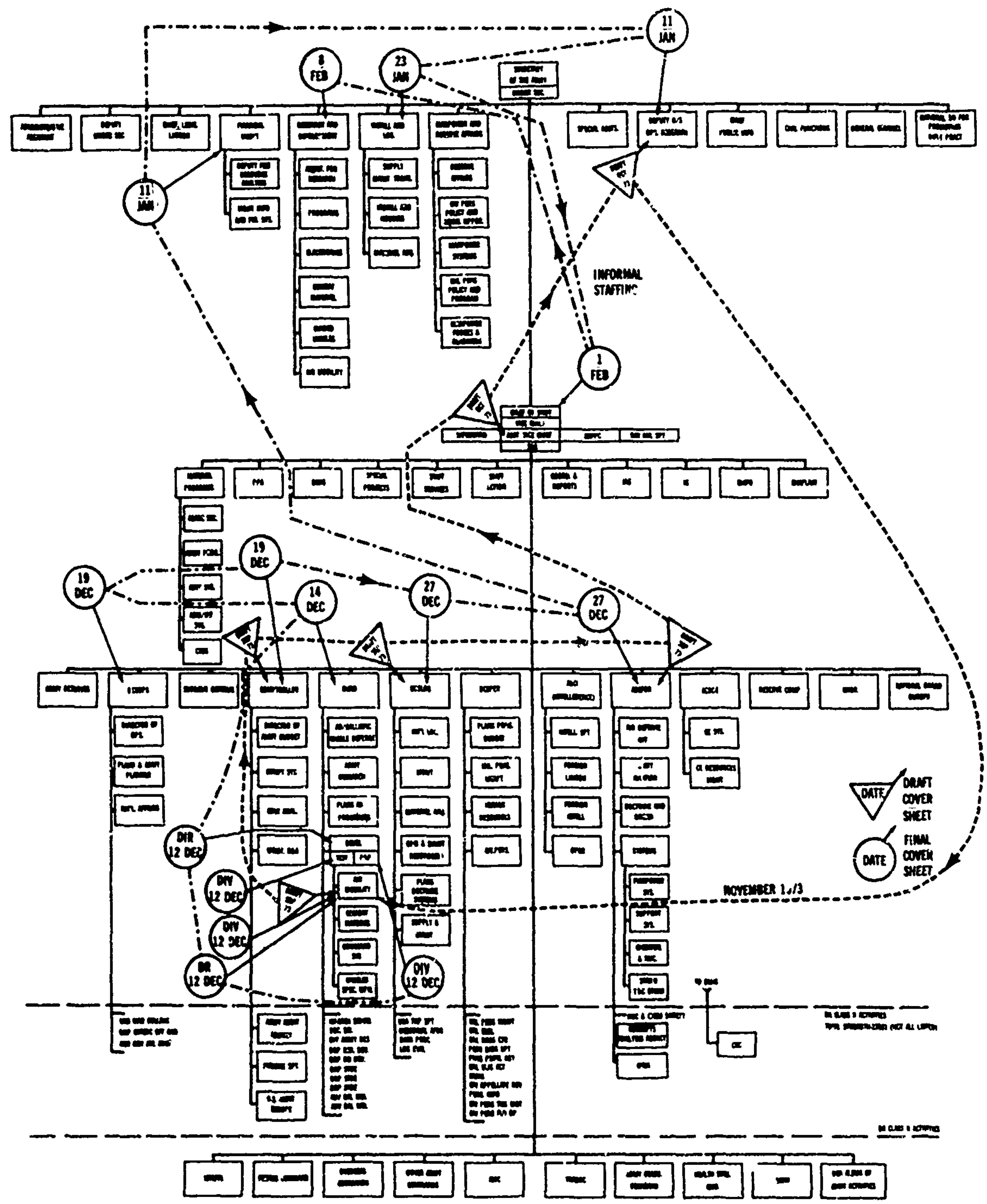


Figure II-3

(2) The total number of people at each layer and the number at that layer devoted to materiel acquisition (research through procurement) vary.

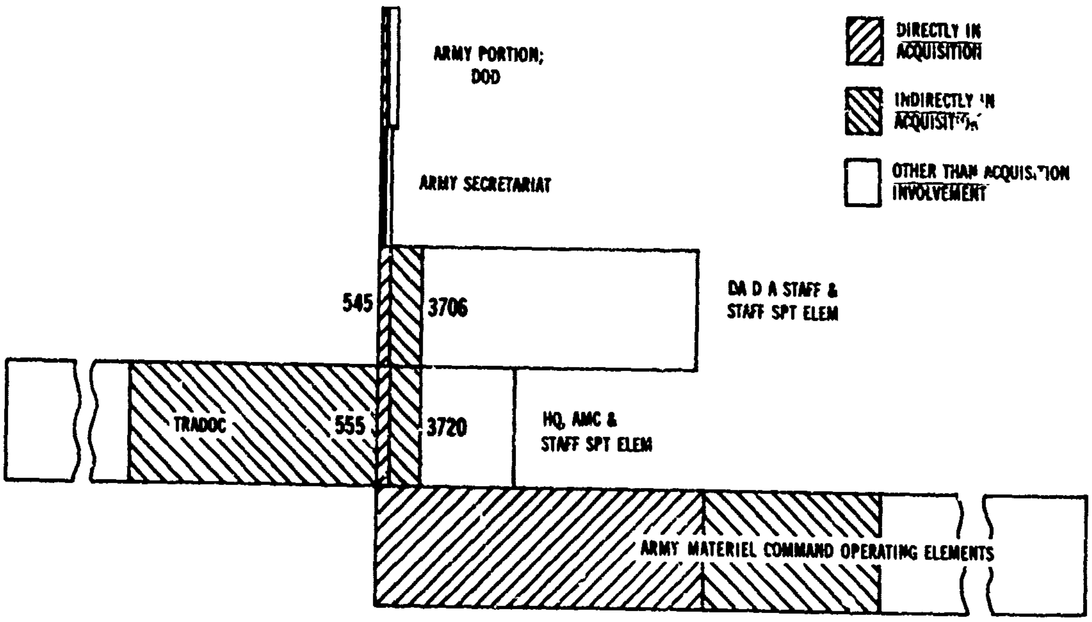


Figure II-4

The total Department of the Army staff involvement is almost equal to that of Headquarters, AMC staff (545 vs 555). Approximately 200 of the DA staff are involved in Communications/Electronics compared to 54 at AMC HQs staff. (Figure II-4)

(3) The proposed Army staff reorganization[7] will assist in the reduction of fragmentation but not the layering.

---

[7] Chief of Staff Memorandum: Reorganization of the Army Staff, 27 February 1974.

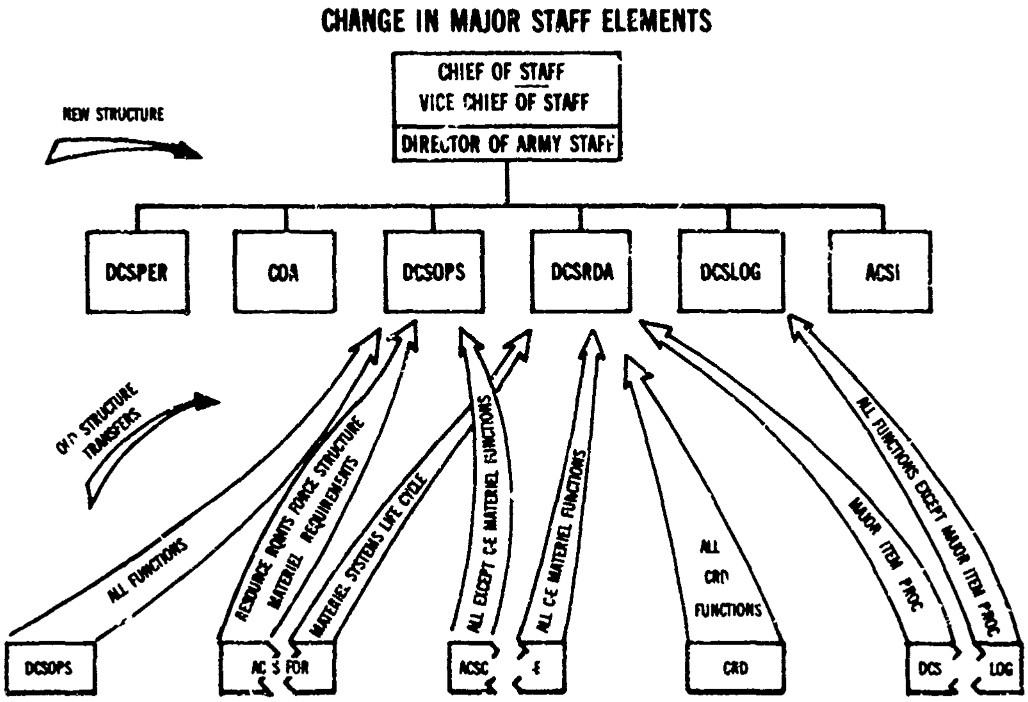


Figure II-5

The number of people on the staff directly involved in materiel acquisition is not appreciably reduced. The total reduction of DA staff and support agencies is approximately 800 spaces. The reorganization also reduces the number of staff agencies involved in the acquisition process. Most of the funds for weapons development will be supervised by one staff element, the Deputy Chief of Staff for Research, Development and Acquisition (DCSRDA). (Figure II-5)

(4) The need to "touch base" with each layer and each staff agency individually, as far as can be determined, has not changed. The project manager is still required to "sell" his system. The PM, Heavy Lift Helicopter, provided fourteen separate information briefings above the level of AMC in the span of nine weeks to the agencies indicated and on dates shown.[8] These 14 briefings in 31 work days included the Christmas-New Year's week, and appear to have required at least five separate trips from St. Louis, MO, to the Washington, DC area. (Figure II-6)

[8] Memorandum for Mr. Shore from PM, HLH, dated 6 February 1974.

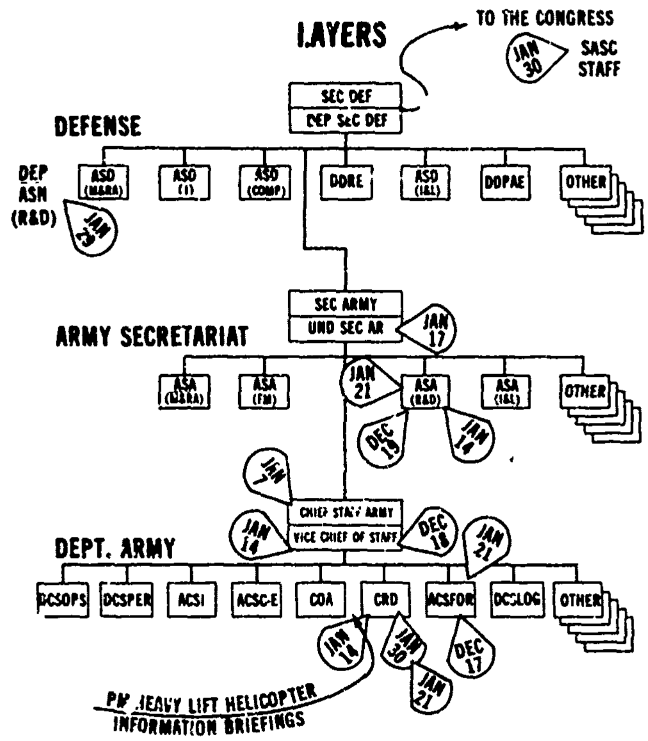


Figure II-6

None were decision briefings. It is clear that the profusion of these briefings take the PM away from his day to day job. Briefings other than for decisions must be eliminated.

(5) The layering and fragmentation also increase the time required to make a decision.[9] This adds to the cost and impedes the schedules of systems acquisition.

---

9 BUSHMASTER has been awaiting decision at least since 1971 for the same issues that confront the system today. Yet, a decision is not available on BUSHMASTER as of the writing of this study. It is seriously doubted that a decision will be made in the foreseeable future.

b. Layering and fragmentation of authority usually lead to rigid procedures and systems of checks and counterchecks. This is true of the Army implementation of the Department of Defense Directive 5000.1. The Army lists six basic policies for materiel acquisition: shorten requirements time, high level decision making, shorten development time, funding priorities, cost vs quantities, and program cost control.[10] These six basic policies and the materiel acquisition life cycle decision points (Figure II-7) provide a basis for discussing the deficiencies inherent in the acquisition policies and procedures.

MATERIEL LIFE CYCLE DECISION POINTS

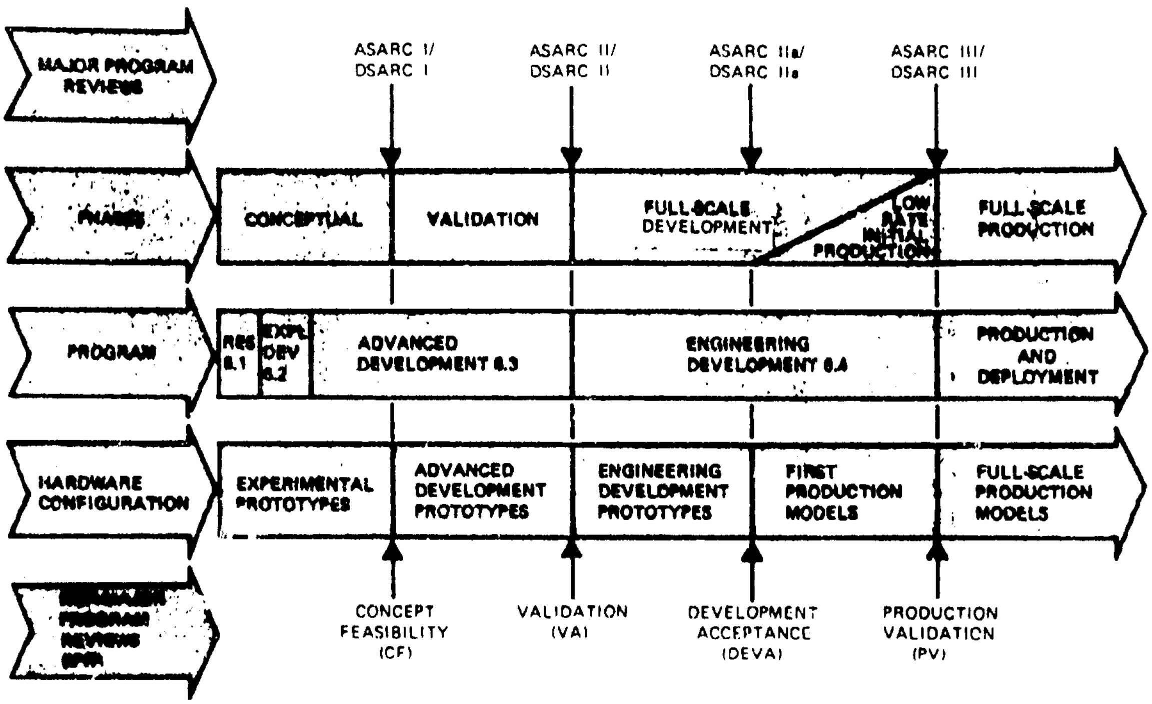


Figure II-7

---

[10] Army Regulation (AR) No. 1000-1, HQ, Department of Army, WASH DC, 30 June 1974.

(1) The process of generating requirements has been shortened by reducing the amount of required supporting data. The Operational Capability Objective (OCO) guides the basic research prior to system definition. The Required Operational Capability (ROC) document currently is the key element in the conceptual phase. The current system requires the appointment of a Task Force (TF) at the end of the conceptual phase. The mission of the TF is to produce a Development Concept Paper (DCP), complete with cost, schedule and performance data. The development of the ROC and DCP are too early in the life cycle. Exact information does not exist at the end of the Conceptual Phase. (For a product improvement more definitive data does exist.) At this point the cost, schedule and performance are still relatively unknown. Not until the end of validation is a new system sufficiently defined to "set in concrete" any meaningful measure of cost, schedule, technical performance or risk. It is at this point that a ROC and a DCP would be meaningful.

(2) The TF concept of preparing a DCP is good. The TF Chairman must have latitude and active support in the selection and timely assignment of qualified people. Further, he must have the authority to deal informally with all line and staff layers without undue interference if the TF is to develop the DCP on schedule.[11]

(3) The Army has instituted its version of the Defense Systems Acquisition Review Committee (DSARC) to involve high level decision makers. The Army committee (ASARC) is currently composed of Department of the Army Secretariat and Army Staff personnel.[12]

[11] In an interview on 23 Jan 74, with MG Powers, TF Chairman, PERSHING II, it was stated that the TF took twelve months to get the DCP approved. The TF Chairman had to proceed in series up the layers to obtain approval. He finished most of the work in three months. At that time, he found he had to coordinate with the Air Force. This required an additional four months. The remaining five months were spent in answering questions and obtaining approval.

[12] AR 1000-1 specifies the principal members of ASARC as the ASA(FM), ASA(RD), ASA(I&L), Deputy Under Secretary of Army (OR), ACSFOR, Comptroller, Chief of R&D and DCSLOG.

The actual responsibility for development belongs to the CG, AMC. The responsibility for user requirements rests with the CG, TRADOC. These CGs and the Chief of Staff/Vice Chief of Staff along with the Secretary/Under-Secretary are the responsible individuals for systems acquisition. We understand that the CGs have been included as principals and that AR 1000-1 will be changed to reflect this addition.[13]

(4) Development time can be shortened if the item enters development after its technical characteristics have been demonstrated to be within the state-of-the-art. At that time cost can be realistically computed. This requires more 6.1 through 6.3 money. The 6.1 effort is not necessarily hardware oriented, however, ideas emanating from 6.1 do feed the 6.2 effort. It is during 6.2 that research becomes hardware oriented. The trend of number of ideas to number of successes may be demonstrated (Figure II-8) by a theoretical situation where the ratio of failure to success may be five to one from R&D program categories 6.2 to 6.3, and during 6.3 we retain two prototypes for competition. The Army appears unwilling to accept increasing the number of concepts in 6.2 in order to increase the number of weapons systems that might be pursued in 6.3.

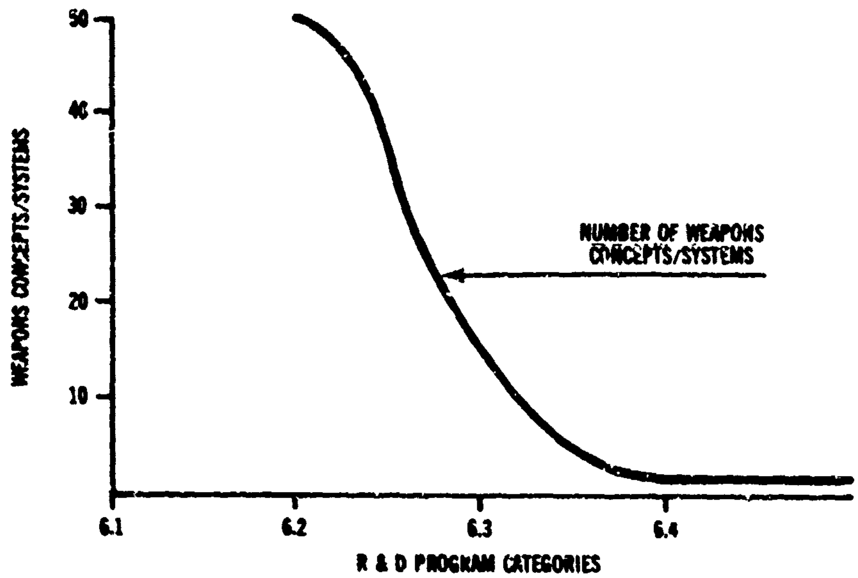


FIGURE II-8

[13] Conversation between COL Ballantyne, OCSA, and Mr. Heintzelman, AMARC, 12 March 1974.

(5) The current procedure suggests that advanced development be competed between at least two prototype contractors, full scale development be undertaken by a single contractor and that he be provided first production. Follow-on production would be competed. We suggest that the Army retain one of the advanced development prototype contractors through production and fielding of the system.

(6) Funding priorities must be met in order not to extend acquisition time. The reorganization of the Army staff should help since it places the research, development, and PEMA funds under one manager.

(7) Scheduling in both the development and production phases is optimistic and does not allow sufficient time for decisions between phases. The milestone management technique is not always compatible with contractual time constraints placed on the project manager. For example, if a decision is not forthcoming from ASARC III, a break will occur between limited production and full scale production; or the decision maker will be forced to allow full scale production to proceed or cause the contractor to hold a production line idle, the unscheduled expense of which must be absorbed by the program.

c. Summary of findings.

(1) Layering of staff, coupled with the need to obtain individual approval at each level from each staff agency creates a need for more and more information and increases the time required for decisions. It actually contributes to indecision. The result is added time and cost.

(2) The number of people involved at every level of review and the depth of their involvement in indivudal systems decisions is excessive.

(3) The reorganization of the DA staff is a step toward reduction of fragmentation.

(4) The ROC and DCP are required too early in the acquisition cycle.

(5) The Task Force concept is good but requires more active support and flexibility.

(6) The CG, AMC and CG, TRADOC are not formally designated principal members of ASARC. Staff members should only advise Chief of Staff/Vice Chief.

(7) The Army seems unwilling to accept increasing the number of concepts in 6.2 in order to increase the number of weapon systems that might be pursued in 6.3

(8) Scheduling of acquisition of new systems is unrealistic and the delay of the decision process can increase program cost.

d. Recommendations.

(1) Examine the layering, number of people involved at each layer and depth of their involvement with the intent of reducing people and eliminating unnecessary review of detail.

(2) Limit information briefings by PMs to one for each level of management and only in support of a decision.

(3) Require the ROC and DCP only after advanced development.

(4) Provide increased flexibility to the Task Force Chairman in the selection of qualified people and informal coordination with all levels of management.

(5) Formalize the appointment of the CG, AMC and CG, TRADOC as principal members of ASARC. Staff members attend only at request of the chairman.

(6) Increase the 6.1 through 6.3 R&D Program Category funds to increase new concepts which will ultimately lead to new weapons. Retain one of the advanced development prototype contractors through production and fielding of the system.

(7) Base acquisition schedules on more realistic decision flow times required to maintain continuity in the development/production phases.

C. MISSION.

1. Mission Deficiency.

a. Proper organization and appropriate delegation of authorities and responsibilities are key ingredients to the successful acquisition process. However, the entire process must originate from a well defined and recognized statement of requirement. The fundamental mission of DOD is to enhance the effectiveness of the US fighting man as economically as possible. Technical sophistication alone does not contribute to combat capability. Deployed capabilities that the fighting man can use are the only returns on investment in R&D. Each project in R&D, regardless of its origin, should be directed toward a recognized future need which will contribute to the DOD mission. Initiatives and directions taken in systems acquisition must reflect requirements derived from real or projected deficiencies in capabilities. Those deficiencies in capabilities should relate to categories of mission areas. The Army has been criticized by the Secretary of Defense for not being able to define deficiencies related to mission areas. [14]

b. The Army does pursue the definition of a system by first defining an OCO which eventually leads to the ROC and DCP. The management by mission area requires that the OCO be in fulfillment of a mission deficiency.

(1) The lack of a complete definition of a **requirement** specifically oriented to a mission deficiency is the biggest single contributor to criticism of the acquisition process. Most of the weapons systems problems can be associated with lack of agreement on some aspects of the requirement and timely decisions: AAH, ARSV, MICV, BUSHMASTER, HLH.

(2) It is not necessary to spend enormous resources on the accomplishment of the mission definition task and concern should not necessarily ensue if more than one service is given authority to pursue weapons within the same mission area. The statement of requirement against deficiency does allow for everyone in the system to relate to a mutual definition of need. It therefore, adds a basis of motivation as well since all programs will, in fact, be in pursuance of a deficiency. Hopefully, it will motivate the developer as well as the user to research new ways of meeting the needs in terms of combat doctrine, force structure and weapon systems.

---

[14] "Talking Points" for remarks by Secretary Schlesinger to the Army scientific Advisory Panel on 29 January 1974.

(3) The functional alignments contained in the DA staff reorganization as yet do not clearly define responsibilities associated with the delineation of mission deficiencies.[15] The delineation of mission area deficiencies in terms of requirements in force and weapons capability is clearly an operations function and, under the proposed Army Staff reorganization belongs to the Deputy Chief of Staff for Operations and Plans (DCSOPS). The Concept Analysis Agency can assist in this role. The delineation of a technical description of a weapon system or group of weapons systems to satisfy that requirement is truly the function of the Deputy Chief of Staff Research, Development and Acquisition (DCSRDA). The management of any conflict between the two staffs and the balancing of funding priorities (broad mission area; not individual systems) can belong to the Director of the Army Staff. Further, the Director of the Army Staff could assist both DCSOPS and DCSRDA in the presentation of these deficiencies and proposed corrections to DOD for approval. The Director of the Army Staff should not, unless directed by the Chief of Staff, become involved in individual weapon system management or analysis.

c. Summary of findings

(1) The lack of a complete definition of a requirement specifically oriented to a mission deficiency is the biggest single contributor to ciriticism of the acquisition process.

(2) The Army's requirements are not expressed in terms of a defined mission deficiency.

d. Recommendations

Define requirements and justify new weapons systems, force structure and doctrine on the basis of fulfilling a defense mission deficit. Appropriate responsibilities for defining mission deficits should be delineated.

---

[15] The term "mission deficiency" refers to a broad mission area and the ability of the Army to totally perform that mission. The fulfillment of a mission deficiency may require more than one weapon system. It may require a change not only in weapons systems but also in doctrine, tactics, and force structure.

2. User Designation/Participation.

a. In the process of developing a new weapon system to fill a definite Army mission deficiency, it is crucial that the intended operational Army unit representative assist in not only the development cycle, but the decision making process as well. The Army organizational element charged with developing doctrine has always been required to represent the operational user. Today the development of doctrine is charged to the Army Training and Doctrine Command (TRADOC), while forces who actually use the equipment are assigned to the Army Forces Command (FORSCOM) and the unified and specified commands.

(1) TRADOC does attempt to coordinate closely with the using units in the field through their doctrinal organization at the different service schools.[16] This is a commendable way to proceed under current policy and procedure.

(2) The Army has a fixation against the developer representing the user. Yet the Project Manager and developer (AMC) at all times seem to be tasked to defend the system need, quantity and configuration. This tendency to place total support of the requirement responsibility on the developer stems from the fact that no agency in the past has completely represented the user. Certainly the real user, a troop unit, has not participated during the development cycle.

(3) The Army has also attempted in the past to involve troop units in testing prior to fully equipping the forces. The tests were designated to take first production run vehicles and let a unit test them under actual conditions. For example, a complement of OH-6 helicopters were given to a battalion sized unit at Fort Knox and tested for six months. All mistakes found were corrected. Once fielded, it was a totally acceptable system.[17]

---

[16] CPT Meier, (Fort Sill), TRADOC representative for MALOR, coordinates each year with the commanders and staff of the 20 units who will eventually receive the equipment. The PM MALOR and the CPT have programmed a trip to the industries concerned to view the prototypes this coming summer. The using units have been invited to send representatives (Telephone conversation between CPT Meier and COL R. L. Moore, 28 Jan 74).

[17] Interview with LTG Gribble, Corps of Engineers, 30 Jan 74.

b. Summary of findings.

(1) There is still confusion over the identity of the real user and his participation.

(2) The lack of agreement on requirements is a major problem which can be traced to the lack of identity of the responsible individual to specify and manage the need. This lack of identity causes continual change and obviates the capability to maintain a corporate memory.

c. Recommendations.

(1) Assign TRADOC the responsibility to manage and justify the requirement in terms of required performance.

(2) Require TRADOC to establish and maintain a user corporate memory.

(3) Require TRADOC, in conjunction with the AMC PM, and early in the development of the system, to establish a close working relationship with the unit (or units) to receive the system. This will allow for coordinated development of the plan of instruction, training aids/devices, training of a cadre of instructors, and will familiarize the using units with development prototypes and capabilities of the new system.

(4) Involve the unit to receive the equipment in the user testing.

D. CAPABILITY.

1. Project Management.

a. The Army philosophy is that a good officer can do anything and that all officers must be trained to serve on the battlefield. At the same time, our technology, our weapons systems, and even our war fighting concepts are becoming more and more complex requiring professionalism and expertise in major functional areas. Weapons systems acquisition is clearly one of these important areas and requires

the Army to train officers to become Project Managers (PM). The problem confronting the Army is to achieve the proper balance in fulfilling these two important requirements. Some progress has been made. Whether that progress has been sufficient is a matter of concern. Several analyses of statistical data are available relating to the effectiveness of Army PM career development. The results of these vary greatly, depending on the assumptions driving the study.[18] The Army should not justify its performance by comparison with past experience or the other services. It should look to changes in the system which will improve project management in the future. Selection, career development, promotion, and authority appear to be four general areas that require improvement.

(1) Initial selection of PMs is accomplished at AMC, since almost all PMs work within the AMC structure. This level of selection seems to give the impression within the Army that only AMC need be concerned about project managers and their importance. Selection procedures must give publicity to the entire Army of the importance of project management, just as the centralized DA selection of district engineers and depot commanders, along with troop commanders, has given Army wide attention to those important positions. The concern of AMC to maintain its control over the selection process, so as to closely monitor the qualifications of those selected to the individual needs of each specific project, is appreciated. This concern can be satisfied by judicious appointment of the DA selection board. This concern can be further protected by providing the CG, AMC, a list of officers in excess to his needs for that period of time, and allowing the CG, AMC to select outside the list if such exception is approved by the Secretary of the Army.

[18] The Logistics Management Institute report, Studies in Support of the AMARC The Project Manager, Task 74-14, March 1974, discusses the statistical data problem and suggests that the main element contributing to the confusion is the consideration given to senior college service attendance. If one compares only Colonel PMs who have attended senior service college with all other colonels in the Army, regardless of their attendance at senior service college, PMs will have attained a higher rate of promotion. If, on the other hand, all colonel PMs (all of whom are supposed to have attended senior college, but some have not) are compared to only colonels who have attended senior service colleges, PMs will not compare as well.

(2) The Army needs to identify prospective PMs and to begin the development of their careers prior to their promotion to major. Current PMs usually have not received the necessary training and experience in procurement, logistics, or research and development. These specialities are managed separately within the Officer Personnel Management System (OPMS). We understand that DCSPER is including a career development program complete with a program monitor. Although project management will not be a specialty in itself, the career development program will include training and assignments in the required existing specialities.[19] The officers desiring to be PMs will be identified early in their careers. The number of military spaces devoted to the acquisition process should be increased, particularly in regards to project management offices. This will allow for increasing the trained officer cadre from which to select future PMs. It allows for augmentation of the civilian workforce with military experience and manpower flexiblity. The amount of increase should be determined by separate study.

(3) The lack of understanding that, under OPMS, project management is as essential a function as troop command, has led most project managers to doubt their ability to compete with their contemporaries who have been troop commanders. The requirement that a PM serve three years makes it difficult for him to serve in that capacity and in troop command prior to his consideration for general officer. If promoted to Brigadier General (BG) prior to completing his three years in a project management office, current regulations would force him to be reassigned unless the position was upgraded. The importance of systems acquisition to the Army mission, as well as the importance of project management, must be understood by those serving on DA General Officer promotion boards. The PMs must be recognized as equal to troop command for purpose of promotion. The Chief of Staff and the DCSPER have recognized this equality. The Army must insure the quality is recognized by all. However, those selected for project management must retain their eligibility to serve as a troop commander if we are to retain the interest of the combat arms officer to serve as a PM.

(4) We found evidence of erosion of authority of the PM

[19]The training in various specialities is termed "interspecialty development". LMI cautions that "interspecialty development" connotes that project management skills can be obtained by simply

by an attitude of distrust by higher authority prevalent throughout the system. The challenging of the PM at every level of management creates an unacceptable mountain of review and re-review that adds cost and results in delays. The total structure seems to be questioning "Why proceed?" rather than asking "How can I help you proceed?" This type of challenge could be limited to specific levels of management such as the CG, AMC and Chief of Staff/Secretary level. Further, review and coordination of work can be accomplished on an exception basis with information copies provided staff wide and concurrence assumed if no reply in 48 hours. Erosion of the PM's authority also occurs when the source of his technical support is dictated within his charter or through policy or procedure. The PM should have freedom in choosing his technical support.

b. The average tenure of PMs is 3.3 years, with a goal of 6 months overlap between the old and new PMs. The current policy suggests that the PM be replaced only at a logical break in the life cycle. This policy appears sound.

c. Summary of findings.

(1) PMs do not believe that the Army recognizes project management as equal to command in terms of promotion criteria. As a result, the PMs feel they are not promotionally competitive.

(2) The attitude of distrust, necessity to challenge and dictating of source of support erodes PM authority and slows progress on acquiring new systems.

(3) The Army proposes to strengthen project management by creating a career development program complete with program monitor. In addition, the Army proposes to identify prospective PMs early in their careers. The current policies on tenure appear adequate.

(4) Headquarters, DA selection of PMs would give total Army recognition to project management.

---

[19]adding some special skill or knowledge obtained from one speciality to those obtained from another. LMI also notes that there is not suggestion in the text of DA Pamphlet 600-3, Officer Professional Development and Utilization, that prior experience in a project management office is desirable in the career development of a PM.

d. Recommendations.

(1) Recognize in OPMS that the PM, as a resource manager, is important; that for purposes of promotion such an assignment is equal to that of commanding troops; that this equality is understood and accepted throughout the Army. Officers should be selected for project manager assignments at grade of colonel by a DA selection board.

(2) Strengthen the belief in project management and make it work. Management should place primary emphasis on assisting PMs rather than thwarting them. PMs should be given freedom of selection of source of technical support.

2. Civilian Personnel Administration.

a. Over a period of many years, the Civil Service regulations have evolved from laws, Executive Orders and court decisions. These regulations guide or control civilian personnel administration. During our visits, three major problem areas emerged with reference to civilian personnel administration.

(1) The current method of administering Reduction in Force (RIF) actions have a devastating effect on any organization. They disrupt operations, lower morale, create uncertainty, and necessitate a chain of unpleasant personnel actions. MICOM had a major RIF in June, 1970 which resulted in the abolishment of 1162 jobs. Before all actions were completed approximately 360 incumbents were externally transferred, retired or died. The elimination of the remaining 800 spaces required more than 2500 personnel changes. This is a ratio of one RIF action affecting three personnel.[20] Interviews at other commands indicated the ratio could be as high as 1 to 5. The cause of this is the "bumping" process, or the act of an individual with seniority replacing a person with less seniority. Theoretically a 20 to 30% reduction could cause displacement of 100% of the civilian work force at any one activity. However, this does not actually happen since some people are displaced more than once while others are not affected at all. Even so, the time, cost and re-training requirements could be staggering. The young technically qualified civilians usually

---

[20] U. S. Army Missile Command Fact Sheet. "Turbulence Related to Reduction in Force", 6 February 1974.

are the most affected. If they are not in a training program, they are usually bumped by senior people who may have less capability for the jobs.

(2) The personnel system responds slowly to civilian personnel needs of newly formed or revised organizations; which require an approved authorization document before recruitment can take place. Once approved, hiring procedures require from three to sixteen months to recruit key personnel. The Utility Tactical Transport Aircraft System (UTTAS) Project Manager provided the history of authorizations versus actual strength. Both fluctuate considerably as shown by Figure II-9. Note that the PM office was

PM · UTTAS STAFF BUILD-UP

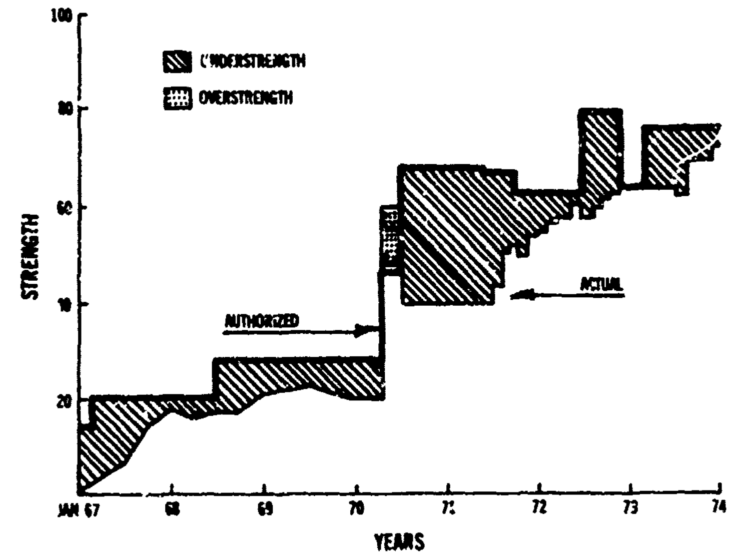


Figure II-9

at authorized strength for a three month period three years after the first authorized space; three months later it was again below strength.

(3) Some personnel management goals do not appear to be compatible. While RIFs are taking place, managers are also asked to reduce their average grade in the organization. Most managers complained bitterly about this problem. They attempt to achieve the average grade reduction by elimination of some top grades as well as lower grades. Unfortunately, the top grades exercise their bumping rights and out go younger employees of lower grades.

b. The magnitude of the problems above can be lessened with logical and flexible interpretation and application of the regulations by civilian personnel administrators. The degree of severity of the problems at each command appeared to be directly related to the cooperation and professional attitude of these administrators. In spite of the apparent restrictions, MICOM found it possible to work within the current regulations and obtain good people, keep the young, and reduce the impact of RIFs. It does require full cooperation and willingness on the part of the managers, the commanders and the Civil Service personnel administrators.[21] This can only be accomplished on an exception basis. Personnel people must be instructed that regulations are guides and as such, should be made to work for the good of the organization as long as laws are not broken.[22]

c. In organizations such as the PM offices, where fluctuations in personnel needs over time change so drafticaally, it may be desireable to establish a nucleus or core of permanent employees and to man to that level. All future requirements above the level could filled by additional military, civilian contract study agencies, PL 313s; consultants or contractors. The core civilians could then be protected.

d. Other means should be adopted to assist offices where authorization levels fluctuate over a short period of time. The Resource Flexiblity Program (REFLEX) might help in this instance. This program, which has been conducted in some AMC laboratories, allows the manager to hire and fire people subject only to the availability of funds and in compliance with Civil Service Regulations,

[21]Interview with Dr. McDaniel, MICOM, 7 Feb 74.

[22]Interview by Mr. Shore with Mr. Mackenzie, Chief, CPO, DCOM 25 Jan 74.

and removes an arbitrary head-count authorization. However, it is limited to research and development spaces.

e. The Department of the Army has recognized the problem of filling vacancies with qualified personnel and is developing new employee evaluation selection criteria on the skills, knowledge, abilities and personnel characteristics required to successful performance on the job. The effectivity of this effort remains to be determined.

f. Summary of findings.

(1) Frequent reorganizations and RIFs that occur at all levels of the Army have a deleterious effect on the morale and performance of civilian personnel.

(2) Under the Civil Service System, RIFs are administered on a seniority first, merit second basis and therefore, are not conducive to hiring and retaining young, qualified people.

(3) There are serious and lengthy delays in manning newly formed organizations such as project management offices and task forces.

(4) Current job classification and recruitment procedures are too strictly enforced, so that personnel who are not fully qualified, (in the manager's opinion) fill technical positions (again seniority, not ability prevails).

(5) The goals of reduction in force, average grade reduction, and maintenance of qualified personnel are not necessarily compatible.

(6) Skillful commanders and managers who understand the Civil Service Regulations can make the system work for them on an exception basis.

g. Recommendations.

(1) Develop a basic level or core organization and

utilize civilian contract study agencies, PL 313s, military, consultants, and contractors to supplement the core organization.

(2) Consider application of the REFLEX program to all research, development, testing and engineering positions.

(3) Consider supplementing PM offices with assistance from civilian contract study agencies.

(4) Expedite the ongoing effort to change the qualification, selection and retention criteria of civilian personnel regulations to motivate employees to advance and compete for jobs on the basis of ability, not seniority.

Annex II-A

BRIEFINGS/VISITS/INTERVIEWS

21 January 1974 — Armament Command, Rock Island, IL.
Interviews with Major General Raaen, CG, Brigadier General VanBuskirk, DCG, Colonel Noce, PM, BUSHMASTER and ARMCOM staff.

22 January 1974 — Rock Island Arsenal, Rock Island, IL.
Briefing by Colonel Agnor, CO, RIA.
Visit Rodman Laboratory.

23 January 1974 — Electronics Command, Fort Monmouth, NJ.
Interviews with:
Dr. Wiseman, Director, RD&E.
Major General Powers, Chairman, PERSHING II Task Force.

24 January 1974 — Electronics Command, Fort Monmouth, NJ.
Briefing by Dr. Wiseman.
Interviews with:
Colonel Harrison, PM, MALOR.
Colonel Wamsted, PM, SATCOM.
Colonel McDowell, PM, NAVCON.
Mr. Bernstein, DPM, REMBASS.
Mr. Goldwag, Dir, CS&TA Lab.
Mr. Greenspan, Dir, Avionics Lab.
Mr. Berger, Chief, Dev., CS&TA Lab.
Mr. Kublin, RD&E staff.
Mr. MacDonnell, RD&E staff.
Mr. Duffy, RD&E staff.
Mr. Weiss, RD&E staff.
Mr. Esposito, RD&E staff.

25 January 1974 — Electronics Command (Mr. Shore only).
Interviews with:
Mr. Sueta, Dep Dir, Avionics Lab.
Mr. Maloney, Chief, ES&I Technical area.
Mr. Post, Pgm Mgr, APN-209.
Mr. MacKenzie, Ch, Civ Pers Ofc.
Mrs. Meisner, Asst Chief.

25 January 1974	Army Materiel Command, Alexandria, VA. Meeting with General Milcy and Lieutenant General Vaughan.
26 January 1974	Defense Systems Management School, Ft. Belvoir, VA. Meeting with Brigadier General Scott, Comdt.
28 January 1974	Telephone conversation with Captain Meier, TRADOC, Ft. Sill, OK.
29 January 1974	Meeting with Lieutenant General Starbird, Director of Test and Evaluation (DDR&E).
30 January 1974	Meeting with Lieutenant General Gribble, Chief of Engineers.
1 February 1974	Meeting of AMARC Chairmen.
6 February 1974	Aviation Systems Command, St Louis, MO. Interview with Major General Hinrichs, CG, and Brigadier General Mackmull, DCG. Briefings by: Brigadier General Lauer, PM, HLH. Colonel Gonzales, PM, COBRA. Colonel Shirey, PM, ASE. Mr. Long, Dep Dir, RD&E. Mr. Crawford, Chief, FS&Q Div, RD&E. Lieutenant Colonel Neu, Ch, Dev Div, RD&E. Mr. Schrekenberg, Foreign Intel Ofc. Mr. Black, Asst Chief, CPO.
7 February 1974	Missile Command, Huntsville, AL. Interview with Major General Ellis, CG. Briefings by: Dr. McDaniel, Dir, AMRDEL. Brigadier General Turnmeyer, PM, LANCE. Colonel Skemp, PM, PERSHING. Colonel Shea, PM, DRAGON. Colonel Dunn, Missile Intel Agcy. Colonel Bennett, Mgr, SIMO, Spec Sys. Mr. Charlton, Dep PM, HAWK. Mr. Cockrell, Dep PM, SAM-D. Mr. Harris, Dep PM, STINGER.

7 February 1974	Missile Command (Continued) Briefings by: Mr. Mangus, Dep PM, HELLFIRE. Mr. Atkins, Tech Dir, AMSMI-RF. Mr. Barber, Ofc, Civ Pers.
8 February 1974	Briefing by Mr. Chapman, Office of Dir, Civilian Personnel-DCSPER, and Mr. Kellett, Army Materiel Command, Office, Civilian Personnel.
18 February 1974	Meeting with Lieutenant General Deane, Chief of Research and Development, Army.
19 February 1974	Meeting with Lieutenant General Rogers, Deputy Chief of Staff for Personnel, Army.
19 February 1974	Meeting with Mr. Trainor, Director, Materiel Programs Directorate, Office of the Chief of Staff, Army.
19 February 1974	Meeting with Major General McKeen, Director of Requirements and Procurement, Army Materiel Command.
1 March 1974	Meeting of AMARC Chairmen.
2 March 1974	Meeting of AMARC Chairmen with the Secretary of Defense, the Honorable J. R. Schlesinger, et al
4 March 1974	Meeting with General Fred C. Weyand, Vice Chief of Staff, Army.
6 March 1974	Tank-Automotive Command, Warren, MI. Interview with Major General Pieklik, CG and Brigadier General Daskevick, DCG. Interviews with: Major General Baer, PM, XM-1 Tank series. Mr. Lenhoff, Dep PM, ARSV. Colonel Brill, PM, HET Systems. Colonel Philipp, Director of RD&E. Colonel Sheridan, PM, M-60 Tank series.

6 March 1974	Discussion with Mr. L. Becher, Program Manager and Mr. W. Farguhar, Director of Staff Activities, General Motors Corporation.
7 March 1974	Discussion with Mr. C. W. Snider, General Manager, Defense Division and Dr. P. W. Lett, Operating Manager and XM-1 Tank Manager, Chrysler Corporation.
7 March 1974	Discussion with Mr. W. L. Shepard, Vice President, Advance Systems and Mr. N. D. Mumford, Program Director for LANCE Program, Ling Temco Vought, Inc.
7 March 1974	Tank-Automotive Command, Warren, MI. Interview with: Mr. W. S. Moyers, Civilian Pers Ofc. Mr. J. Nouse, Chief, Systems Analysis Ofc.
13 March 1974	Litton Industries, Data Systems Division, Van Nuys, CA. Interviews with: Dr. N. A. Begovich, President, DSD. Mr. J. F. Lawrence, VP, Finance & Contract. Mr. J. P. Harding, VP, Engineering. Mr. G. E. Miller, Program Management. Mr. Ed Peyronnin, Contracts.
13 March 1974	Summa Corporation, Hughes Helicopter Company, Culver City, CA. Interviews with: Mr. Tom Stuenpnagel, VP and Gen Manager. Mr. John Kerr, AAH, Program Div. Mr. Marc Gerardis, Dir, Finance & Admin. Mr. Ray Deyo, Manager, Contracts & Pricing.
13 March 1974	Hughes Aircraft Company, Culver City, CA Interviews with: Mr. Fred Eicher, VP, HAC. Mr. Joe Scanlon, PM, TOW. Mr. Robert Tucker, Contracts. Mr. Ki Thomasson, PM, COBRA/TOW.

14 March 1974	Philco-Ford Corporation, Palo Alto, CA. Interviews with: Dr. Gett, Technical Director. Mr. Raymond Ezekiel, Comptroller. Mr. Warren Palmer, PM. Mr. Jack Keyes, Vice Pres.
14 March 1974	Lockheed Missile and Space Company, Sunnyvale, CA. Interviews with: Mr. E. P. Wheaton, VP & Gen Manager, R&DD Div. Mr. H. P. Kerfoot, VP & Asst GM, R&DD Div. Mr. J. Freeman, LMSC Dir, Finance. Mr. W. D. Orr, LMSC Contracts Ofcr. Mr. I. Trowbridge, PM, XM-808, SCOUT. Mr. D. M. Schwartz, PM, FAMECE. Mr. J. Lawson, PM, Helicopter Hoist. Mr. M. McGilvray, LMSC Dir, Company Materiel. Mr. E. G. Timm, R&DD Contracts Manager. Mr. C. F. Banker, R&DD Contracts Admin. Mr. W. M. Eaton, R&DD Manager, CSCSC SCOUT Program.
22 March 1974	Meeting with LTC Robinson, Concepts Analysis Agency, Bethesda, MD.
22 March 1974	Meeting of AMARC Chairmen.
23 March 1974	Meeting of AMARC Chairmen with CG, Army Materiel Command and staff.

CHAPTER III
PRODUCTION TEAM REPORT

A. SUMMARY.

1. General. The scope of the Production Team's study was centered on the production aspects of the Department of Army's materiel acquisition process, including those actions taken during the development phases which impact on production as well as other disciplines and constraints which affect production decisions, i.e., mobilization needs, arsenal production capabilities and logistical support alternatives. The Production Team recognized that the production phase of the acquisition process is influenced by many factors; however, due to the limited time allowed for this study, an attempt was made to identify and deal with those factors that most significantly impact on production schedules, cost and capabilities. The areas of major concern were:

a. Acquisition Strategy.

b. Life Cycle Support.

c. Industrial Preparedness Planning.

d. In-House Production Facilities.

2. Acquisition Strategy.

a. The primary reason for the Army to initiate development of a new weapon system is to produce, deploy and support a system for a stated mission need. In order to accomplish this, we believe that the formulation of a detailed "acquisition strategy" for individual systems or programs prior to program initiation is the single most important factor in establishing a weapon system acquisition program. "Acquisition Strategy," as used herein, refers to a mutually supporting series of plans for translating the goals and management needs of the total life of a specific program into a series of interrelated actions to accomplish the program. The purpose of an acquisition strategy is not to gain approval to initiate a program, but to establish a foundation through a series of plans upon which the acquisition and logistical support of a weapon system can be accomplished. Such an acquisition strategy must interrelate the various discrete acquisition policies to the peculiar needs of an individual weapon system or program so that the resulting overall plan enables the Department of Army (DA) to buy equipment that meets its stated operational needs, at planned affordable costs, within schedule and logistical support goals.

b. DA must amplify and perfect its procedures for developing acquisition strategy relating to weapon system programs to assure that:

(1) The acquisition strategy is developed by experts knowledgeable in the functional areas of equipment technology, procurement, production, costing and logistical support (to include contractor support of fielded systems, warranties, etc.).

(2) Reviewing authorities insure that the developed acquisition strategy includes flexibility against which trade-offs can be effected within (a) the stated program goals, (b) the competitive environment and (c) the overall management plan in order to assure early consideration of producibility, design-to goals (production and logistical support), and contractor support of fielded systems.

(3) Key participants in the development of an acquisition strategy continue in positions of responsibility in the program.

3. Life Cycle Support. The total resource implications of the approval to initiate development and fielding of a new weapon system are not identified early enough in the life cycle of a weapon system. Life Cycle Cost (LCC) factors are given a rather cursory look by the Task Force (hereinafter referred to as the planning group) and top level decision makers prior to a decision to proceed with the development of a weapon system. In order to ensure that such considerations are adequately evaluated, the following actions must be taken:

a. The logistic support structure required to support a weapon system should be identified by the planning group establishing a program and reviewed throughout the life of the program.

b. The advantages in the use of life cycle cost procurement for high dollar components and repair parts must be emphasized. To accomplish this, the Army must establish a workable cost collection and accounting system for support costs (operations and maintenance) by weapon system.

4. Industrial Preparedness Planning. Investigation revealed that guidelines for Industrial Preparedness Planning (IPP) do not provide for situations of partial mobilization such as experienced during the Korean and Vietnamese conflicts. Thus, many "planned producers" of military equipment will not convert from civilian to military production until, and unless, a state of mobilization is declared. Force levels to be supported in situations of less than full mobilization must be identified.

In addition, the responsibility for IPP should be centralized within one directorate of the DA staff in order to eliminate the current fragmentation of IPP responsibility.

5. In-House Production Facilities. While Government-owned production potential is necessary for those items where industry does not have the capability to meet Government requirements, there is significant underutilized production capacity in the Army arsenals.

6. General Observation. We believe that a specific milestone schedule for implementation of approved AMARC recommendations should be established within 30 days of the receipt of the report by the Secretary of the Army. Such specific milestones are required if the work of this Team and the Committee is to bear fruit.

B. ACQUISITION STRATEGY.

1. Finding. There is a lack of realistic and thorough planning for system acquisition.

2. Discussion.

a. In evaluating strengths and weaknesses of the Department of Army's procedures for materiel acquisition, consideration must be given not only to those actions which are accomplished during the production phase, but also to decisions made during both the initial strategy planning phase and the development phases. To the extent that the acquisition strategy for a weapon system is thoroughly analyzed and followed during the design and development phases, the transition of that equipment into the production phase can be accomplished efficiently and within planned costs and schedules. If, on the other hand, the acquisition strategy is inadequately structured or not followed during the design and development phases, the transition of the equipment into the production phase is faced with numerous problems. In recognition of these needs, the Department of Defense and Department of Army issued acquisition guidelines in the form of DOD Directive 5000.1 and AR 1000-1. These guidelines provide an excellent basis for establishing an orderly acquisition strategy which, if fully followed, will provide the decision makers with the meaningful data on which to manage the program. While the basic policies for acquisition management are clearly stated, there is a need within Headquarters, Department of Army to amplify and perfect the disciplines contained within those policy statements.

b. The primary objective of a materiel acquisition strategy is to establish a series of mutually supporting plans upon which the acquisition and logistical support of that weapon system or item of materiel can be accomplished. Such plans would enable the Department of Army to buy equipment that meets its stated operational needs at planned affordable costs, within schedules and geared to a logistic structure that will provide proper life cycle support.

c. The task of developing a sound acquisition strategy must be accomplished by a group of individuals representative not only of the technical disciplines,but also of the various management,business and acquisition disciplines. This requires that the specialties represented on the planning group include, as a minimum, the management disciplines of procurement, production, logistics and cost estimating. The technical representatives should be able to address the characteristics of desired systems and relate those characteristics to the current "state-of-the-art" of component development programs both in-house and in industry. Between the management and technical representatives, an acquisition strategy should be developed which will consider all features of the program including program cost, schedule and technical risks in relation to the resources available for the program. The resulting strategy should thus provide a foundation for a well structured program to maximize motivation of the contractor(s) who will perform the development and production phases.

d. At the heart of an acquisition strategy is the need to establish well defined program goals and management plans, together with a means of tracking progress toward their achievement throughout the acquisition cycle. Even at the point of entering full scale production, a program remains quite vulnerable to technical uncertainties. When the program is further compounded by changes in needs, schedules, goals and funding levels, the probability for chaotic disaster becomes very real. If early decisions to establish these goals are unsound and/or if the technical methods to meet even valid goals are unsound, the risk in successfully managing the system or of achieving a realistic production package is unacceptable.

e. It is essential, therefore, that these goals and needs be reaffirmed at the end of the development cycle and before the first production run. The actual system to be produced should then be measured against the revalidated requirement. Production should be allowed to proceed only after the proper reviewing authority, which must include the "user," has affirmed that the system in question is

capable of meeting a valid need. Simply stated, a program cannot be allowed to go into the costly production portion of the acquisition cycle until informed judgment, backed by adequate testing, has affirmed that it is capable of meeting a valid need.

f. The acquisition strategy must establish an environment which requires and motivates the Government and the contractor to continually utilize cost effectiveness and trade-off analyses to provide the proper weapon system in an economical fashion. Extreme care must be taken to motivate the developing contractor to design a system meeting the optimum cost effective goals of each discipline. For this reason, the minimum essential number of characteristics need to be stated in the form of bands of requirements (to include goals and least acceptable). The design-to-unit production cost goal must reflect the affordability of the equipment. The logistical needs of a system must provide for a proper life cycle support program. Needless to say, design of the system should reflect cognizance of these needs. The Program Manager must be alert to and have the responsibility and authority to prevent arbitrary or marginal requirements from prohibiting the contractor in making effective cost trades and thus assure that the Government does not otherwise impede the contractor's technical efforts.

g. The Army cannot lose sight of the fact that the requirements (qualitative and quantitative) of a new program determine the cost and complexity of the system. Therefore, they must be solid at the beginning of the acquisition and carefully monitored throughout.

h. In planning total strategy early in the acquisition cycle, there is a natural tendency to place major attention on the design, engineering and development phases. Certainly, it is necessary to place emphasis in these areas, but not at the expense of similar consideration for production and support requirements. The ultimate objective remains, however, to develop a producible system that, when deployed, will accomplish the desired purpose. Probably the greatest improvement that can be made to the production phase is more realistic and thorough production planning early in the acquisition cycle. It is imperative, therefore, that skilled production and logistic personnel actively participate in all phases of planning and implementing an acquisition strategy.

i. A number of production related matters must be adequately treated in any such plan. They include, but are not limited to:

(1) Insuring realistic and effective competition.

(2) Producibility.

(3) Quantities to be procured.

(4) Delivery schedules.

(5) Allocation of resources.

(6) Requirements for technical data.

(7) Methods of contracting.

(8) Logistic support structure and requirements.

j. The task of developing a sound acquisition strategy must be placed with the program manager, or officer to be designated PM, who is responsible to implement and manage the program. It is essential, however, that top approval authorities be aware of the cause and effect of each policy, key technical cost and schedule elements in a given acquisition strategy and challenge those which they believe to be unacceptable. Once the strategy is approved, it must be fully supported by all involved from top management (ASARC as defined later herein) on down and carefully reviewed throughout the acquisition process.

3. Recommendation. There is a need within the Army for realistic acquisition planning early in the life of an acquisition program. Such a plan should be a part of the ASARC-I presentation and reviewed and updated throughout the acquisition cycle.

C. UTILIZATION OF PRODUCTION SKILLS IN ACQUISITION PLANNING.

1. Finding. Knowledgeable personnel skilled in the disciplines of procurement and production are not assigned a proper role early enough in the development of acquisition programs.

2. Discussion. The primary motivation of a planning group for a major system is directed at developing enough data to satisfy approving authorities that a program needs to be established without thorough planning of outyear management actions. There is a need for procurement and production personnel to play an integral part in such planning efforts

and to assure that the effects of design and development requirements are evaluated in light of their effects on the producibility of the equipment at affordable costs during the production phase. Such production considerations include, but are not limited to, qualitative and quantitative requirements, competition, funding, mobilization requirements and producibility of the system and key components. An acquisition program must not be approved and implemented without all elements of the program strategy clearly defined.

3. Recommendations.

a. All acquisition strategy planning groups must contain knowledgeable personnel skilled in the disciplines of procurement and production as an integral part in the development of the acquisition program and related strategy.

b. Key members of the planning group must continue in management positions subsequent to program approval.

D. COMPETITION.

1. Finding. Too little attention is given to the development and maintenance of an effective competitive environment for full scale production of complete systems and major subsystems/components thereof.

2. Discussion.

a. In our review of various missile programs, it was noted that competition of initial production quantities for the purpose of establishing a second source has proven to be a most cost effective means of bringing competitive pressure to the full scale production phase. In contrast, it was noted that a number of aviation programs have placed the competition in all, or a portion, of the development phases with an aim at directing the attention of the competing contractors to design the most cost effective system possible, thereby receiving the production contract. While both of these procedures offer the opportunity for substantial cost savings, it is our opinion that the most effective of these two procedures is to have the competition in the design phase so that the competitive pressures are directed at the design of a system which meets the qualitative requirements at the lowest production unit cost. It is generally desirable that such competition be carried through the full development phase. This has

the added advantage of providing a second source for production, thereby assuring that proposals for full scale production are based on the most efficient manufacturing techniques. If it is impractical to compete the development program, establishing a second production source for full scale production must be considered. While this procedure does not, by itself, assure cost effectiveness of the system design, it causes each contractor to search for the most efficient manufacturing process. It should also be noted that positive application of the "Design-to-Unit Production Cost" policy should provide adequate motivation to sole source contractors in the design phase so that production unit costs are the lowest practicable, particularly if the program would be cancelled if such costs are considered excessive.

b. While competitive development and second source production programs have been established for a number of systems, it was noted that little attention appears to be placed in requiring similar competition for either high technical risks or major subsystems/components. Such action could negate a substantial portion of the benefits anticipated from competition at the prime level. Also, consideration should be given to the Government procurement of high dollar value subsystems to be provided as Government furnished equipment to the system prime contractor.

c. In evaluating competitive alternatives of proposed new weapon system programs, consideration should be given to the use of commercially or NATO developed equipment which could be adapted to DA needs. Additionally, thought must be given to the commercial or NATO application of the equipment to be developed. To meet this goal, consideration could be given to the inclusion of commercial and/or NATO user requirements so that the equipment application will be broader than just DA needs. In some cases, it should be expected that the statement of equipment characteristics, while containing essential DA military characteristics, might contain less than all desired characteristics in order to meet NATO and/or commercial user requirements.

d. The acquisition strategy considerations should establish a competitive environment which will evaluate the merits of commercial or NATO equipment in comparison to a proposed new program, particularly one where a sole source contractor is involved. The resulting competitive environment, even though sole source, should cause the development contractor to be motivated to design the most

"saleable" item with due consideration given to technical performance, production unit cost, operating and logistical support costs. For this motivation to be realistic, the acquisition planning phase needs to be accomplished with full consideration given to the probability of use by commercial or NATO sources.

e. In all cases where a competitive base exists, maximum effort should be taken to limit contract awards to proven producers. It is an accepted fact that the source selection process should possess a "memory"; thus, evaluation of past performance of a contractor should be considered a major factor in contract award. Competitive negotiation based on a system description and available technical data is one alternative that should be explored.

f. The establishment of a competitive environment is the essence of successful weapon system acquisition.

3. <u>Recommendations</u>.

a. For large dollar programs, which preclude competition at the prime level during development, require that maximum consideration be given to the establishment of a production second source for full scale production, particularly after the placement of the initial production order with the developer.

b. Consideration should be given to requiring development contractors to provide second sources for high technical risk subsystems/components whether or not the development contract is sole source or competitive. Competition between such sources should be maintained at least until full scale production.

c. If economical considerations rule out the competition of high dollar value subsystems/components by DA, the development contractor should be required to provide for establishment of multiple subcontract sources for competition of the component at the time of entry into the full scale production phase.

d. During the acquisition planning process, consideration should be given to the acceptability of, or modification of, commercially or NATO developed equipment and/or the inclusion within the statement of qualitative requirements of commercial or NATO characteristics which would cause the developed equipment to be "saleable" to other customers.

e. Acquisition planning and development contract clauses should include alternatives which would require the introduction of a second competitive source when the development contractor is encountering difficulties which indicate a high degree of risk in the design or producibility of this system, thereby jeopardizing the achievement of the stated Design-to-Unit Production Cost goal or other program goals.

E. PRODUCIBILITY PLANNING.

1. Finding. Producibility evaluations are currently not a formal requirement of early system design development phases.

2. Discussion.

a. While project and commodity managers are urged to evaluate and determine the producibility of an item during the design phase, the degree to which such actions are accomplished varies among systems. Generally, it depends on the tenacity and management abilities of the project manager for the system, and the capabilities and practices of the development contractor. The Army must introduce producibility considerations into the existing procedures for the formulation and review of system acquisition. The ultimate measure of success of a program is procurement of the essential item at an established, acceptable price. To achieve that end, designers, production engineers and potential vendors must be brought together early in the development cycle to seek design approaches which will insure good producibility and minimize both production and support costs, while meeting system qualitative requirements.

b. During our review, it was noted that some contractors have made excellent use of the Work Breakdown Structure and performance measurement system for cost and schedule to validate the producibility of the system under design. Additionally, producibility achievements have been reported to program managers on the Cost Performance Report. It should be noted that although appropriate implementation of the design-to-cost policy will encourage early producibility considerations, it cannot be relied on as the sole means for effecting producibility planning.

3. Recommendations.

a. The Project Manager responsible for the acquisition of the system should be charged with the Governmental responsibility for producibility evaluations.

b. The Request for Proposal and contract should provide for contractor evaluation of producibility considerations during the early development phase.

c. There is a need for a management mechanism to enable the Project Manager or commodity command to review producibility data submitted by the contractor. Where practical, this information should be made an integral part of the Cost Performance Report and producibility costs goals assigned to the Work Breakdown Structure (WBS) with achievements related to the completion of each WBS package.

F. MILITARY SPECIFICATIONS AND STANDARDS (MILSPEC/STD's).

1. Finding. Application of MILSPEC/STD's, during the system design phase, are excessive, impede the flexibility of design engineers and add unnecessarily to the total cost of the system.

2. Discussion. Most systems presently in the prototype design phase contain a requirement that the contractor(s) design a system, which in addition to meeting various qualitative requirements, must also comply with numerous (in excess of 200) MILSPEC/STD's. Such MILSPEC/STD's are specified by various users as well as logistical and materiel developer specialists with little cost trade-off consideration of their impact on the production unit cost. Contractors have reported that it is most difficult to gain waivers since the program manager seems to have little real authority to overrule the specifications concerned (a major problem). Additionally, when the system is involved in a competitive design environment, contractors are reluctant to request even cost trade-off considerations for fear that their competitor(s) will meet the requirement of the specification, thus, probably gaining a competitive advantage in the source selection evaluation. One alternative is to state, for the initial design only, equipment safety requirements leaving the balance of the otherwise required MILSPEC/STD's as factors for evaluation during Development Test/Operational Test-I. In this way, the contractor could, during the design phase, apply generally accepted commercial standards and have full flexibility to conduct cost trade-offs. During subsequent

phases of development and prod· ·ion, the design could be strengthened, if necessary, by applicable M.. ..PEC/STD's. RFP's should state, in po· ·ive terms, the interest to trade-off MILSPEC/STD's for production or ..fe cycle cost savings.

3. Recommendations.

a. MILSPEC/STD's must be held to a minimum:

(1) For design development contracts, no MILSPEC/STD's should be stated except those individually approved by HQ, DA.

(2) MILSPEC/STD's stated in subsequent engineering development and production contract should be subject to an ir. nsive review at all levels of the Department of Army.

b. The PM must have full directive authority to waive requirements of MILSPEC/STD's which, through the conduct of trade-off analysis, are not determined to be within the overall program objectives.

c. Contractual clauses must be flexible and stated so as to encourage the contractor to conduct trade-offs and request cost effective waivers.

G. DESIGN-TO-COST.

1. Finding. Definitive steps have been taken to implement the DOD Design-to-Cost (DTC) policy, although the management philosophy thereof is only now evolving.

2. Discussion.

a. It was noted that DTC goals have been generally established in all appropriate Department of Army weapon systems. Basically, these actions have followed Office, Secretary of Defense policy to limit such cost goals to a unit production cost estimate. The procedure for establishment of such goals has varied from a detailed parametric cost estimate to a statement of affordability by the DSARC. Considerable difficulty has been experienced in preparation of parametric estimates due to conflicts between a field command and higher authority, resulting in disagreements as to the appropriate methodology and cost data used. Additionally, estimates have been approved at the total system level

with no approval as to the discrete cost elements on which they were based. This fact has, in turn, created problems in the management of actual costs in relation to the approved estimate. For the DTC policy to be fully effective, appropriate flexibility must be given to the program manager and contractor designing the system.

b. Some contractors have experienced difficulty in effecting thorough review and in gaining waivers to contractual requirements which they believe are non-cost effective. Contract clauses should encourage contractors to submit cost-effective waivers of technical and operational contract requirements.

c. The control and management of the DTC estimate must be placed at a sufficiently high level (i.e., PM) to assure that inter-Government disciplines (qualitative requirements, MILSPEC/STD's, Reliability, Availability, Maintainability, Government Furnished Equipment, etc.) do not adversely impede achievement of the Design-to-Unit Production Cost goal. The attitudes of Government personnel whose decisions impact on the acquisition process must be directed towards cost trade-offs within the overall goals of each weapon system program. The DTC manager (PM) must have full directive authority to assure maximum trade-offs within the overall cost and performance goals of a program.

d. The policies and procedures for management of the DTC are presently evolving. It was noted, however, that there is considerable variation in the DTC methodology as to which production quantities the stated goals apply; i.e., first large scale production quantity, average production quantity for total buy or some portion thereof.

3. Recommendations.

a. The methodology for computing each category of DTC should be established during the early planning phase of a new weapon system and approved in advance prior to approval of the program by all levels of review.

b. The approved DTC estimate should be in such detail as to permit the breakout of discrete cost elements that make up each DTC cost category so that actual costs can be tracked to that estimated.

c. A cost threshold for program cancellation must be established and included within the approved DTC guidance.

d. Achievement of the DTC should be related to the average production unit cost of the first major production contract.

e. The management disciplines and ASPR provisions should be reviewed to assure that they do not restrict the PM from providing a contractor full flexibility in conducting trade-offs in the design of a system in order to meet the DTC.

f. DTC goals should address, insofar as possible, overall costs of ownership including support costs, not merely investment costs alone.

H. LEAD ACQUISITION COMMAND.

1. Finding. The management process for some major weapon systems is impeded due to the assignment of management responsibilities of major subsystems to AMC major subordinate commands (acquisition commands) other than the command having responsibility for the primary system.

2. Discussion. The management process for a major weapon system is most difficult considering the various user, testing and development agencies which impact on the program. When the management process is further fragmented due to the assignment of management responsibility for major subsystems to commands other than the command developing the primary system, the effectiveness of the project manager is further diluted. When two or more commands are involved in the acquisition of a weapon system, the command having primary interest should be designated as the "lead" acquisition command. This command would have primary responsibility to insure the successful acquisition of the system, including subsystems and components related thereto. All funding and programming for the system should be handled through, and controlled by, the lead acquisition command.

3. Recommendation. Where two or more acquisition commands are involved in the acquisition of a weapon system, a lead command should be designated.

I. ACQUISITION OF TECHNICAL DATA.

1. Finding. Acquisition plans are overly optimistic as to the future use of a complete Technical Data Package with a resulting data acquisition which is in excess of actual needs.

2. Discussion.

a. Substantial amounts of resources are committed to the acquisition, review, updating and general maintenance of a complete Technical Data Package (TDP) which does not appear commensurate to the actual use to which the data is applied. There is a tendency, during the initial planning phase, to over optimize the future use of a TDP. In many cases, the development contractor's manufacturing drawings might well satisfy the total logistical needs of the Government.

b. The procedures for determining the adequacy of a submitted TDP are at best marginal. The only real test is the ability of second sources to use the TDP in a successful production effort. Thus, the possession of a TDP gives the developer and the Army a false sense of security. All efforts to continually update and maintain the TDP are of questionable value unless a second source is to be, in fact, established.

c. The United States Army Electronics Command, for example, has recently reevaluated its policy for acquiring and maintaining TDP's. In many cases, current production procurements are being solicited, based on a performance specification with the available technical data provided the contractor, as a reference guide.

d. Problems relating to the acquisition of all types of technical data were discussed in the report of the Commission on Government Procurement (Volume 1, Part A, p 81) and are commended to the reader of this report.

3. Recommendations.

a. A required minimum level of technical data should be determined at the beginning of the acquisition cycle and continuously reviewed thereafter to validate the required level.

b. Actual procurement of a TDP should be delayed as long as feasible, and the requirement, therefore, revalidated immediately prior to actual procurement.

J. AWARD FEE DETERMINATIONS.

1. Finding. Award Fee determining officials are not, in all cases, at a high enough level to evaluate the overall achievement of the contractor.

2. Discussion. The award fee evaluation criteria contained within most contracts is very specific as to the factors against which the incremental fee is to be based. These factors tend to be various detailed performance requirements against which the contractor is designing the system. During the course of a program, a contractor may have a major accomplishment for one factor with marginal or less than stated accomplishments in other areas. The award fee determining official should be at a sufficiently high level to objectively evaluate overall performance. Flexibility must be incorporated into award fee determining criteria to prevent contractor performance from being measured solely by individually audited performance items. If this is accomplished, the award fee procurement technique offers an excellent opportunity for senior members of the Government to convey to contractors their assessment of his performance in meeting the defined goal of the total program, even though some individually audited items may have met less than assigned goals.

3. Recommendation. In the administration of award fee contracts for major systems, the determining official should be at the Project Manager or higher level to assure that an overall objective determination is made in relation to the total program goals.

K. HARD/RATE TOOLING.

1. Finding. The requirements for Hard and Rate Tooling are stated and planned for acquisition unnecessarily early in the acquisition process.

2. Discussion. Under current procedures, the needs for Hard/Rate Tooling are originally estimated in the acquisition strategy at the time of initial program approval. Subsequent changes are difficult to implement, even though they may represent improved analysis of economic production rates and methodology. This frequently results in the procurement of unnecessary and costly tooling. The acquisition of hard tooling could be frequently deferred until completion of full development and operational testing of the equipment design. Such action will require that DT/OT-II tests be directed at the identification

of all major design deficiencies, so as to minimize the design changes resulting from DT/OT-III. Hard tooling could then be acquired during the producibility engineering and planning phase, which would minimize the transitional problems from development to limited low rate production. The acquisition of a full complement of rate tooling should be deferred until completion of DT/OT-III.

3. Recommendations.

a. Acquisition of hard tooling should be deferred until completion of DT/OT-II tests and the full complement of rate tooling until completion of DT/OT-III tests.

b. A study should be conducted by HQ, DA and AMC to analyze the alternate procedures that could be utilized to assure that tooling requirements are stated for the most economical production rate and manufacturing process.

L. ARMY SYSTEMS ACQUISITION REVIEW COUNCIL (ASARC).

1. Finding. The ASARC organization is cumbersome and the review process does not provide for adequate interim evaluation of program progress.

2. Discussion.

a. As originally conceived, the ASARC was composed of members of the Secretariat, VCSA (Chairman) and all Deputy Chiefs of Staff with the exception of DCSPER, DCSOPS, ACSI and ACSC-E. Recently, the AVCSA issued instructions to include the Commanders of AMC, TRADOC and OTEA at all future ASARC reviews. The size of the group, as well as the usual agenda, tends to minimize the effectiveness of their review. As it presently functions, the ASARC principally acts as a pre-DSARC review group and not as a program status review group for major programs. Since DSARC meetings are held at major milestones in the acquisition cycle or when a stated Development Concept Paper threshold has been exceeded, their meetings on any one system are extremely infrequent.

b. It is our opinion that the ASARC membership should be revised as follows:

(1) Secretary/Under Secretary of Army - Chairman.

(2) Army Secretariat - Members.

(3) CSA/VCSA - Member(s).

(4) CG, AMC.

(5) CG, TRADOC.

c. The ASARC (principals only) should meet at least quarterly to review the status of major weapon systems such as the "BIG 5" programs or other programs experiencing acquisition problems. Additionally, the CG, AMC and CG, TRADOC should be required to provide input to the quarterly reviews. All other additional participants should be invited to attend meetings of the Council at the discretion of the Chairman. The review of briefings to be presented to the DSARC should be conducted by the sponsoring member of the Secretariat and DCS concerned, although major DA decisions/positions included therein should be reviewed and approved by the ASARC. In no case, should more than one review be held at Headquarters levels (including AMC, DA staff and Army Secretariat).

3. Recommendations.

a. The ASARC concept should be revised to require review of the status of major programs on an on-going basis with the Program Manager.

b. The ASARC membership (principals only) should be limited to the SA/USA (Chairman); Army Secretariat; CSA/VCSA; CG, AMC and the CG, TRADOC.

M. PROGRAM OBJECTIVE MEMORANDUMS (POM).

1. Finding. The present method of resource allocation through the POM/Budget cycle is not conducive to the realization of optimum production quantities.

2. Discussion. The POM/Budget cycle functions independently of the acquisition strategy and management process. In that the program manager's ability to follow an approved acquisition plan is contingent on the recept of current year funds, there needs to be a closer relationship between the POM/Budget Cycle and program review/decision process. Production quantities and schedules should be set at the optimum rate and any deviation should be fully justified and approved by the Secretary of Army.

3. Recommendation. DA should issue guidance which will coordinate the POM/Budget Cycle with the acquisition strategy for approved programs.

N. MULTI-YEAR PROCUREMENTS AND SUBCONTRACTING PROCESS.

1. Finding. Economic factors, existing at the present time, require a review of policies and practices relating to multi-year procurements and subcontracting.

2. Discussion.

a. Multi-Year Procurements.

(1) Existing policy and practice utilize the techniques of multi-year procurements and priced production options. This practice particularly in connection with the final development contract has, in the past, proven to be most advantageous to the Government and contractor alike.

(2) Today, however, there is an increasing inability to obtain firm schedules and prices for many items. This is particularly true where long leadtime items or materiel are involved. As a matter of fact, leadtimes are developing for some items that were formerly procured basically "off-the-shelf" from commercial distributors.

(3) A combination of these factors makes it extremely difficult for the contractor or the Government to predict out-year production costs, particularly where they form the basis for a contractual commitment.

b. Subcontracting.

(1) Subcontractors are an essential part of any procurement process. The presence of a dynamic and healthy group of subcontractors is integral to the successful achievement of any major acquisition program.

(2) Basically, subcontractors are subject to the same, or more stringent, contractual obligations as the prime contractor. This has, and probably will remain, a continuing problem of both Government and industry. The conditions, as set forth above, are serving to accentuate the difficult problems of the subcontracting portion of the Government-prime contractor team.

3. Recommendations.

a. Existing policies and practices relating to the use of multi-year contracts and production options (particularly in the latter part of the development cycle and in the production cycle) should be carefully tempered with detailed consideration given to the existing economic environment as well as realistic projections for the future. Use of this type of contracting, and cost estimates based thereon, requires a careful and continuing review by Army management and acquisition officials.

b. Additionally, these same factors require that emphasis be given to the problem of maintaining a viable subcontractor and vendor base.

O. DEPARTMENT OF ARMY USE OF PRODUCTION WARRANTIES.

1. Finding. The Army does not generally consider the use of commercial warranties in the acquisition of new system/equipment.

2. Discussion.

a. A significant portion of the procurement program of the Army is comprised of commercial or commercial-type items. Specific examples of this type of procurement include the procurement of commercial vehicles pursuant to the Army WHEELS Study. Unlike similar commercial procurements by other agencies, the Army does not make a practice of obtaining commercial warranties. Protection to the Government, as well as a reduction in the procurement of supply parts and test equipment, could be attained if commercial type warranties were obtained.

b. Studies are currently underway as to the desirability of applying commercial warranty practices, as a standard part of development contracts, as an additional motivation to the development contractor to design a cost effective system. This may well be too hard a policy to adopt across the board, however, experimentation is in order. The Army should begin to "test the water" looking toward greater use of commercial type warranties in production contracts.

3. Recommendation. DA should more thoroughly examine the use of commercial warranties on all applicable equipment on an experimental basis.

P. ECONOMIC ORDER QUANTITIES AND FUNDING CONSTRAINTS.

1. Finding. Funding constraints for replenishment repair parts tend to preclude economical quantity buys and to increase the number of small quantity procurement requests to satisfy requirements.

2. Discussion. Funding constraints should be removed from replenishment items, including repair parts so that economical order quantities can be made. Such action would not only result in lower procurement costs, but a drastic reduction in the volume of procurement actions and elimination of extensive "hand massaging" now required. The Aviation Systems Command has recently completed a study of repair parts procurements and has adopted a procedure to make economic order purchases of low dollar value items (items with gross annual dollar demands under $5,000) direct from the computer print-out up to a $3,000 level.

3. Recommendation. Department of Army should relax funding constraints so as to maximize the purchases of economic order quantities.

Q. LOGISTIC SUPPORT PLANNING.

1. Finding. Department of Army guidance does not include a requirement for a proper logistic assessment in the planning of an acquisition program.

2. Discussion.

a. DODD 5000.1 and 4100.35 require that logistic considerations be integrated into the conceptual phase and through the entire design process. The DA Letter of instructions (LOI) for Implementing the New Materiel Acquisition Guidelines, dated 23 August 1972, does not call for a logistic assessment in the ROC. Section VI of the LOI requires that a Logistic Support Plan be prepared but in an inadequate manner.

b. We believe that the initial qualitative description of a proposed weapon system should contain a brief statement that would insure the equipment acceptability to logistic support concepts in effect at the time the equipment is fielded. In addition, a preliminary

Integrated Logistic Support Plan (ILSP) should be developed as part of the Task Force (or equivalent) effort.

c. The materiel developer is responsible for preparing the logistic support plan to be included in the Development Plan. The current decision making process does not provide a mechanism whereby the Army can be assured that the developer has properly considered support system actions during all phases of development.

d. The cost associated with logistic support usually far exceeds the development and initial acquisition costs of a new system. It is, therefore, essential that life cycle support costs be identified to the fullest extent possible, and as early in the acquisition process as practicable, for consideration by top decision makers prior to a decision to proceed with the development of a weapon system, or to consider trade-offs in favor of logistics where supportability and total support costs dictate that this is practical.

3. Recommendations.

a. The initial qualitative description of a proposed weapon system should include a logistic assessment statement.

b. A preliminary logistic support plan must be developed as part of the weapon system planning group effort.

c. Logistics support expertise should be represented on weapon system planning groups, be afforded full visibility of the logistic support plan, and participate throughout the acquisition cycle.

R. CONTRACTOR SUPPORT OF FIELDED SYSTEMS.

1. Finding. Current Department of Army acquisition procedures do not require that contractor support of fielded systems be specifically addressed early in the procurement planning phases of a weapon system acquisition.

2. Discussion.

a. Contract support of fielded systems readily lends itself to many Army systems, particularly of commercial type.

b. The feasibility of having a contractor support fielded systems should be evaluated during the early planning of a new weapon system and included with the acquisition strategy. When it is determined that a system will be contractor supported, the Government should indicate to competitive contractors early in the development cycle that it plans to consider contractor support of the system at the time of contracting for initial production.

c. Depots, service maintenance and logistic elements comprise a significant percentage of DA manpower. A significant increase in the Army's combat personnel could probably be obtained by a greater utilization of industry in supporting major systems and equipment. Furthermore, contractor support of fielded systems could enhance Industrial Preparedness by sustaining the contractor in production over an extended period of time. This might also encourage contractors to become "planned producers."

d. Total Life Cycle Costs for a weapon system would probably be reduced in view of the fact that a winning contractor knows that he will be responsible to maintain and supply the system.

e. In following this policy, however, the Army must give due consideration to procuring parts competitively from other sources.

3. Recommendation. That DA require specific consideration of contractor support of fielded systems early in the acquisition cycle and continuously throughout the cycle.

S. LIFE CYCLE COSTING.

1. Finding. There is a lack of high level emphasis in exploiting the life cycle cost acquisition concept.

2. Discussion.

a. There is a need for Life Cycle Cost (LCC) consideration in the performance of all functions of the acquisition process from the initial design phase through the evaluation of engineering change proposals during full scale production. For such LCC consideration to be properly implemented it is necessary that DA correct the deficiency which exists in the availability of LCC data for deployed weapon systems. Increased emphasis is therefore required in

developing a LCC data collection system and in perfecting the technique by which such data is used in the acquisition process of major weapon systems and subsystems/components. This is particularly important when applying the DTUPC policy so that reliability and maintainability considerations can be protected. Additionally, LCC consideration must be accomplished by contractors as well as the Army and should be used in decisions concerning alternatives to satisfy a requirement or to continue, curtail or discontinue a program.

b. The LCC procurement technique is a procedure whereby a source of supply is selected based on the total cost of a product over its useful life as opposed to just its acquisition costs. The technique is a useful means of assuring that the resulting acquisition is in the best interest of the Army, considering the total cost of acquisition and ownership. While the LCC procurement technique is admittedly difficult to apply, there has been insufficient high level emphasis on its application. Responsibilities for application of the technique have been fragmented at all levels of the Army (HQ, DA; HQ, AMC and major AMC Subordinate Commands).

c. We find that industry does not believe that DOD/Army is serious about applying LCC. Industry's perception is that DOD/Army is primarily concerned with acquisition costs of development and production. This assumption must be corrected through positive action by all levels of the Department of Army.

3. <u>Recommendations</u>.

a. Increased emphasis should be placed on the application of LCC procurement by the DA staff and HQ, AMC. Procedural guidance should be provided AMC field commands delineating specific responsibilities.

b. Stress increased use of LCC procurement of high dollar components and parts.

c. Increase research in techniques of application of LCC in the acquisition of systems and subsystems; and in particular, when applying design-to-unit production cost.

d. Develop a data system to identify LCC elements (operations and maintenance) by weapon system.

T. INDUSTRIAL PREPAREDNESS PLANNING (IPP).

1. Finding. Current Army planning for Industrial Preparedness fails to identify a realistic force structure that justifies retention of existing production facilities as well as those required at the time of mobilization.

2. Discussion.

a. The IPP Program provides the equipment and maintenance support for the force levels specified in the Annual Secretary of Defense Materiel Support Planning Guidance as implemented by DA Policy and Guidance. AMC is responsible for selection of items necessary to meet its industrial preparedness planning objectives based on DA Policy and Guidance. IPP is required for a relatively small percentage of Army items in order to provide production base capabilities before an emergency arises, since production capacity for the bulk of these items is consistently available from commercial sources. The Army limits its total planning list to approximately 2,000 items. The Army Materiel Plan (AMP) is used as the basic planning document.

b. Declining consumption rates, coupled with a reduced force structure, have reduced IPP requirements to a point where existing facilities could not be retained at a level that was otherwise considered realistic. In addition, since substantial partial mobilization could occur before the formal declaration of M-Day, the assumption that increased support will not be required before M-Day appears to be unrealistic. Experience in the Korean and Vietnamese Conflicts clearly indicates the lack of realism in this assumption. Therefore, since the size and mix of the force to be supported is basic to the validity of mobilization planning, the force levels identified for IPP need to be high enough to permit retention of production facilities necessary to support full mobilization.

c. An analysis of the current HQ, DA organization and assigned functional responsibilities shows that the authority for various areas that impact significantly on mobilization planning is fragmented among major staff elements with further separation within staff elements, e.g., if primary responsibility for coordinating all aspects of IPP were centralized in a single HQ, DA office and the functional responsibilities of the organization for IPP were broadened, realistic mobilization planning would be facilitated.

d. During the past two years, AMC has significantly increased its emphasis and applied substantial resources to its Industrial Preparedness Planning Program. An annual study of the production base is conducted to provide continued visibility of the program. The annual recertification of production packages insures retention of needs and action to dispose of excesses. The Production Base Plan (PBP) resulting from the annual study provides data on various aspects of industrial preparedness, and provides analysis of these data. It identifies Industrial Plant Equipment voids against the Planning/Retention Level requirement. For example, the Army FY-75 PBP identifies a $18,262,000 void in the production equipment package at Rock Island Arsenal. AMC commands are continually screening the DOD General Reserve in order to fill these voids.

e. Another problem impacting on realistic production base planning is that many "planned producers" of military equipment will not convert from civilian to military production until, and unless, a state of mobilization is declared.

3. Recommendations.

a. Identify a more realistic force level against which industrial mobilization planning will be accomplished.

b. Industrial preparedness authority should be centralized in HQ, DA.

c. Introduction of industrial preparedness planning early in the acquisition process should be made a matter of policy.

d. Overhaul and maintenance requirements should be more fully considered for use in sustaining mobilization base requirements.

e. The $18,262,000 plant equipment package void at Rock Island should be critically reviewed.

U. IN-HOUSE PRODUCTION FACILITIES.

1. Finding. There is idle production capability in the Army arsenal system.

2. Discussion.

a. Arsenal Production.

(1) We found idle production capability in the Army arsenal system and duplication between the arsenal and depot rebuild capabilities. Approximately two-thirds of the arsenal (seven arsenals) production capacity is in excess of current requirements. Such unused production capability exists at Frankford, Edgewood, Rock Island, Rocky Mountain and Watervliet Arsenals. The continued maintenance of such capacity results in a costly and unnecessary burden on Army materiel acquisition and support programs. If additional workload is not placed in these facilities so as to make them cost effective, idle capacity should either be excessed or "moth balled" to meet possible mobilization requirements - or a combination of both. Due consideration must be given to the capability of meeting Army requirements, through private industry, in-house depot rebuild capability and arsenal capacity. In this connection, it must be borne in mind that Watervliet Arsenal has a capability not duplicated in any respect by either private industry or other Government in-house production facilities. For example, the unique machine tools, particularly lathes and autofrettage equipment, installed at Watervliet Arsenal for the production of large caliber tubes, are not found elsewhere nor are they practical of economic construction at another location. This must be maintained as an integral part of the Army in-house production capability.

(2) Some technical base is also required for fabrication of prototype quantities where an item is designed in-house. This capability can be retained in the AMC laboratories.

b. Modernization of In-House Production Facilities.

(1) The Army Materiel Command plant equipment and machine tool replacement program is implemented through AMC Regulation 700-22 and AMC Pamphlet 700-2.

(2) The procedures outlined in AMC Regulation 700-22 apply to plant equipment purchased under the Procurement of Equipment and Missiles, Army (PEMA) appropriation. These procedures do not apply to plant equipment purchased for use in depots under the Operations and Maintenance, Army (OMA) appropriation. Furthermore, while this regulation includes provisions for replacement of plant equipment at Government-owned, contractor-operated plants, there is no provision

to determine if private industry is investing in similar equipment that could be utilized on a contract basis for the manufacture of Army eriel. Thus, current procedures do not provide for comparison the benefits to be obtained in installing a new piece of plant equipment either at an arsenal or a depot or in private industry. This situation must be corrected, particularly in the areas where tooling is required to support rebuild operations.

(3) AMC Regulation 700-22 requires that each facility report on the utilization of newly installed plant equipment for only one year following installation. However, such equipment investment decisions are based on amortization within a period of five years. Thus, the Army has no realistic mechanism to check the validity of the internal decision. In view of the fact that manufacturing quantities and items can vary significantly from year-to-year in an arsenal, usage data should be developed for newly installed plant equipment for a period of up to five years. This data would then be utilized as a basis for evaluating new plant equipment investment recommendations.

(4) The Army currently plans to invest over $75 million for new plant equipment and modernization at the Detroit Tank Plant. Lease or sale of this plant would probably result in a more modern and efficient facility than could be achieved through the present GOCO arrangement. A provision could be added to the lease or sale agreement that would give the Government the option of regaining this facility upon partial or full mobilization.

3. Recommendations.

a. Army Arsenals.

(1) Retain production capability only for those items where industry does not have the capability to meet Government requirements.

(2) Eliminate idle arsenal production capability giving due consideration to depot level rebuild capability.

(3) If current direct labor manpower authorizations are increased to a level which would permit efficient utilization of the arsenal production capacity at Rock Island, a study should be conducted to determine the relative cost effectiveness of a GOCO versus GOGO operation at this arsenal.

b. Modernization of In-House Production Facilities.

(1) AMC should require that:

(a) Modernization projects for both depots and arsenals be centrally reviewed for potential consolidation/elimination of modernization projects.

(b) Utilization rates for new machine tooling be reported for the first five years (or until the investment is amortized) after installation of the new equipment in order to validate the benefits stemming from the investment.

(2) Consideration should be given to the lease or sale of the Detroit Tank Plant to the winning XM-1 contractor with the provision that control would revert to the Army in the event of partial or full mobilization.

Annex A

BRIEFINGS/VISITS/INTERVIEWS*

23 January 1974	Electronics Command, Fort Monmouth, NJ.
25 January 1974	Tank Automotive Command, Detroit, MI. Mr. Becher, General Motors Corp. Dr. Lett, Chrysler Corp.
1 February 1974	Missile Command, Huntsville, Al.
5 February 1974	Watervliet Arsenal, Watervliet, NY.
14 February 1974	Secretary Bowers, ASN(I&L). Headquarters, U.S. Army Materiel Command.
19 February 1974	Pentagon: LTG Coffin, Deputy Director (Acquisition Management), DDR&E. Dr. Payne, Deputy Under Secretary of the Army (Operations Research).
21 February 1974	Rock Island Arsenal, Moline, IL.
22 February 1974	Aviation Systems Command, St Louis, MO.
25 February 1974	LTG Kalergis, Assistant Vice Chief of Staff, U. S. Army.
26 February 1974	Boeing-Vertol Company, Philadelphia, PA.

* In addition to those listed above - Mr. Sanders, Dr. Shea and Mr. Esposito interviewed numerous other DOD and industry officials during the conduct of the study.

CHAPTER IV
COSTING TEAM REPORT

A. INTRODUCTION.

1. A history of cost growth on major weapon systems has generated problems of instability within the programming and budgeting system while at the same time undermining overall Army credibility. The Costing Team was chartered to review the organizations and procedures involved in the cost management function, to highlight strengths, and to make detailed recommendations for improvement.

2. The principal investigative technique was a series of intensive visits and interviews at all levels of the Army, OSD, and non-defense agencies, as summarized in Annex A. Case studies of past and ongoing weapons systems as well as reference to the existing body of literature and reports of various panels and commissions supported the interviews. The Costing Team wishes to acknowledge and express its sincere appreciation to all the individuals and organizations who gave so generously of their time and knowledge to assist us in our task.

3. It should be noted that many of the recommendations made by the Costing Team have been made before and will be made again unless the Army is serious enough about improving its costing capability to initiate fundamental changes in organizational objectives and motivations.

4. Our investigation showed that, while recent organizational and policy changes within the Department of the Army have resulted in many substantive improvements, there are still serious problems in the Army's cost estimating and analysis system. This report makes no attempt to address all of the problems discovered; rather it discusses those which appear most serious and emphasizes changes that give the greatest opportunities for improvement.

5. In this context, it must be observed that simply issuing the appropriate directives and regulations is not adequate to achieve the changes required. In a process as complex as weapons system acquisition there is no reason to believe that a piece of paper will be able to convey the full meaning of desired changes, much less the reasonable exceptions which are sure to exist, or the full rationale for the desirability of the change.

6. For these reasons, our recommendation on how the Army should implement the recommendations presented in this report is to support its implementing documents with a team of specialists who can visit the concerned agencies, get them started in the right way, and then check periodically on their progress. This will be an expensive process but the Army cannot afford not to do it.

7. The Team self-limited the scope of its investigations to a consideration of major weapon system cost estimating, analysis and management during all phases of the materiel acquisition process. The area of contract pricing was reviewed only enough to examine the basic interactions with the costing function, but was not examined in detail.

8. The process of cost estimating can employ several techniques, depending upon the amount of information available to the cost analyst. In the early stages of the acquisition process when developed prototypes are not available, product and program costs are often estimated using parametric cost estimating techniques which relate physical and functional parameters to cost as experienced on previous similar development and production programs.

9. As the weapon system design evolves, analogy estimates based upon a cost comparison of similar systems provide an additional tool for determining the expected product and program costs. Finally, industrial engineering or "bottoms-up" cost estimating techniques replace the analog and parametric techniques as the major tools for detailed cost estimates once engineering or production drawings are available.

10. All three methods can then be used concurrently to establish the "best" cost estimate. Appropriate application of these estimating tools can provide reasonably good predictions of product and program costs exclusive of the effects of unknown program changes, unanticipated technical difficulties, and unexpected changes in economic conditions. Often, as a program progresses these outside factors raise formidable problems that must be dealt with by the cost analyst. In fact, they cause many of the costing problems we have today.

B. SUMMARY.

1. Costing Capability.

a. Issue The Army's ability to prepare accurate cost estimates has been seriously questioned. While the basic capability to prepare cost estimates was found to be better than generally thought, there are some fundamental managerial problems associated with the way in which the process is conducted.

b. Discussion.

(1) The organization for preparing and processing cost estimates to the DSARC is neither logical nor clearly understood by those people in the Army who are involved in the process.

(2) The flow of independent cost estimates through Comptroller channels is a slow process which dilutes responsibility for the quality of the work while creating a counter-productive adversary relationship among the various staff levels. Management problems are intensified by the large number of cost estimates, on short time schedules, which are required particularly in the early stages of acquisition.

(3) Cost estimation is a function which is not closely aligned with the Army's operational definition of Comptrollership and therefore is not enhanced by placement in the Comptroller channels.

(4) Other than their own personal standards, cost analysts do not perceive that there are any substantial incentives which the system offers for good work. The Army has many dedicated and capable people in its cost analysis activities. More comprehensive training programs would be useful in improving the professionalism and skills of costing specialists in order to further enhance the Army's capabilities in this important field.

(5) The cost estimating data base of the Army is uneven in quality and varies from poor-but-improving to adequate. On the other hand the results obtained from that data base, discounting other factors which cause cost growth (requirements changes, inflation, etc.), appear to be within reasonable ranges of accuracy for research and development and production efforts.

c. Recommendations.

(1) The Army should publish a general policy statement which

establishes guidelines concerning the responsibilities of various organizations for the generation and flow of baseline and independent cost estimates. A recommended statement of detailed policies and procedures is presented in Annex B to this report. In brief, this requires the independent cost estimate prepared at the Commodity Command to be identified, to be reviewed but not changed at higher echelons (except in response to altered project content), and to be processed parallel to the Project Manager's baseline cost estimate.

(2) The weapons system costing function should be removed from the Comptroller channel at all levels. At the Commodity Commands and AMC it should be established as a separate office reporting directly to the Deputy Commanding General. In DA Headquarters it should be established as a separate office reporting to the Vice Chief of Staff.

(3) The Army should undertake a priority program (in coordination with the other services and OSD) to validate data collected previously and to collect and validate data on additional systems in anticipation of recurring cost analysis needs for accurate historical data on defense systems. This recommendation must be administered selectively since such an effort, while productive at a command which has relatively few large systems (e.g. MICOM and TACOM), might not be productive at a command with relatively many small systems (e.g. ECOM). It must also be assessed at each command to determine if additional resources will be required.

(4) For those systems now being acquired by the Army, an individual in the Commodity Command concerned should be assigned responsibility for compiling and documenting data on system physical and performance characteristics, costs, schedules, and milestones paying particular attention to evolutionary changes and their real causes. The same selectivity as above applies.

(5) Both the professionalism and incentives of cost analysts should be improved by requiring a cultural change on the part of high level managers such that they recognize costing personnel as valuable team members and provide a proper environment for their professional advancement. They should be included as active participants of Source Selection Evaluation Boards.

2. <u>Downward Bias In Cost Estimating</u>.

a. <u>Issue.</u> In addition to uncertainties associated with unexpected economic conditions, technical difficulties, and program changes, the quality of the overall cost estimate can be downgraded by a downward estimating

bias in the preparation and processing of major weapon system cost estimates. This downward bias stems from either conscious or unconscious attempts to portray optimistically the expected program outcome and incurred costs.

b. Discussion.

(1) Program advocacy, and the desire to sell programs in the face of budget stringency, are strong drivers toward the preparation of optimistic estimates. We believe that the Army can estimate expected costs, but that currently an estimate has little chance of resisting the downward pressures which operate at all levels.

(2) The appropriate responses to such pressures are (a) preparation and publication of estimates made independently of the advocates, and (b) assignment of program management accountability for achievement of the advertised results which includes PM retention until the results can be assessed. Both of these avenues should be pursued.

c. Recommendations.

(1) The Army should take the necessary steps to emphasize the necessity of establishing a highly visible baseline cost estimate which will remain with the project throughout the review cycle and the subsequent acquisition process. The baseline estimate, with detailed updated estimates resulting from project changes, should result in a complete cost estimating history for the program.

(2) The uncertainty associated with estimating costs should be recognized and quantified in both baseline and independent cost estimates for all major weapon systems. Estimates incorporating optimistic and pessimistic values together with expected values of program costs should be visible through ASARC/DSARC decision levels.

(3) The Army should support the preparation and recognition of independent cost estimates. The independent estimate should augment the baseline estimate by providing additional information and by refining the baseline cost estimating uncertainty bandwidth through the use of alternate estimating methodologies when appropriate. The independent estimate, like the baseline estimate, should remain with the project, with appropriate updating resulting from changes, throughout the program.

(4) The Army should adopt a policy of leaving project managers on the job until the completion of a life cycle phase in order to establish greater costing accountability.

(5) A Project Manager's performance appraisal at the conclusion of his assignment should assess and reflect his accountability for cost management.

(6) Schedule estimating efforts should be linked to cost estimating efforts to emphasize their interrelationships and to provide for an expanded data base from past experience. The impact of program actions on schedule and manpower loading, as well as on program costs, must not be overlooked.

3. <u>The "Buy-In" Problem.</u>

a. <u>Issue</u>. Contractors often propose costs that are unrealistically low in relation to the work to be done in an effort to win competitions. This results either in apparent cost growth or in the work being shorted, or both.

b. <u>Discussion</u>.

(1) "Buying-in" refers to a contractor strategy in which an unrealistically low cost is proposed, usually on a development job of cost-reimbursable type, in the effort to win a competition. Buying-in is undesirable if: (a) the low figure proposed really is substantially less than what should be spent in the particular development job, and the managing agency fails to recognize and correct the situation; (b) the buy-in is successful and results in choice of a contractor who will not serve as well as another not chosen; or (c) it leads to a de facto sole-source procurement situation.

(2) Strategies to counter buying-in and its evils are designed to operate counter to (a), (b) and (c) above. They must be applied carefully to avoid unjustified spending (or its appearance) or the selection of the wrong development contractor. The focus must be on buying a development, not buying an estimate.

c. <u>Recommendations</u>.

(1) The agency should make sure that sufficient funds to conduct development properly are programmed. In the event that a contractor has proposed and contracted for too low a figure, and there is danger of bona fide development work being shorted as a result, appropriate changes should be negotiated. In a development program, by definition, not all issues can be anticipated. Thus, sequential decision making is required

(2) A resolute attempt should be made to prevent successful buy-in maneuvers. In the evaluation of proposals, credit should be given for sound and substantiated cost estimating. Source selection boards should consider what actual costs will likely turn out to be for each of the several proposers. Cost-type development contracts should be negotiated after selection rather than before, to avoid leveling and to reduce the tendency toward unsound cost proposing.

4. Life Cycle Costing

a. Issue. The need for and the definition and conduct of life cycle cost (LCC) analyses are less than clear to DOD personnel. In any event, the capability to estimate the annual recurring Operations and Maintenance (O&M) costs, both direct and indirect, is extremely doubtful. However, life cycle cost estimating should be addressed, and future cost impacts of weapon system ownership must be considered. Acquisition and operation of weapon systems under peacetime budget constraints means that full costs of ownership are becoming major determinants of force composition and defense capability.

b. Discussion.

(1) Currently over 55% of all Army costs relate to manpower. With manpower costs continuing to increase rapidly it is imperative that conscious choices be made to select systems with the lowest costs (for equal effectiveness) over their total life. Thus, the Army must assess the operational cost implications during the critical development period[1], including tradeoffs based upon these considerations. We find that this is not being done.

(2) The Army is making some progress in maintenance cost reporting. Coupled with sampling, this could lead to a better data base. In addition, a good deal more work is needed in defining fully what costs should be included in the costs of ownership. Until the data base is improved, there should be no hesitation in using whatever data are available, albeit rough, in making such estimates for tradeoff purposes during development, even though confidence is low. Naturally, the level of confidence should be made explicit.

[1]That period in development when important tradeoffs are made in establishment of the system's design.

c. Recommendations.

(1) The Army should seek innovative ways to support strongly Mr. Clements' Directive of 25 January 1974 on "Visibility and Management of Support Costs." The effort is basic to improving the Army's ability to estimate O&M costs, both direct and indirect.

(2) Top management in the Army should question how and at what cost their new systems will be maintained during their operational lifetimes. For example, they must insure that designs to reduce acquisition costs do not increase O&M costs by more than the hoped for saving or that increases in acquisition costs are more than offset by O&M cost savings.

(3) Life cycle cost estimates, and the rationale for their generation, should be included in all major weapons acquisition decision processes such as ASARC and DSARC, even if they are only of "order of magnitude" quality initially.

(4) The Army should, on a continuing basis, assess future O&M costs during the critical development period of a weapon system in order to influence the ultimate design toward optimized cost of ownership, performance, and operational availability.

(5) In order to improve the quality of the data base, the Army should pursue sampling techniques as a potential substitute for widespread maintenance cost reporting, or alternatively, as a means for determining accuracy of reported data.

5. Cost Estimating For Design-To-Cost.

a. Issue. The design-to-cost (DTC) acquisition philosophy as it is presently being applied by the Army has resulted in unit production cost targets directed at controlling unit costs during volume production. The success of this management concept is critically dependent upon the DA and supporting contractor abilities to estimate a realistic future production cost and the PM's freedom to make adjustments to meet it.

b. Discussion.

(1) The design-to-cost concept depends upon the ability to establish a unit production cost which will be affordable, consistent with the baseline performance parameters, and utilized as a primary design parameter. However, the establishment of viable cost goals

will require unbiased and accurate estimates of future production costs which have not been attainable to date.

(2) Many problem areas have been identified in the Army's initial experience in the design-to-cost method of acquisition. Cost estimating problems exist in estimating future macro and micro economic variables, evaluation of competitive proposals, and DTC information exchange. One result of these problems is that we tend to be suspicious of some of the DTC goals which have been established. The solution to the problems identified will require learning from past mistakes and adoption of successful program management techniques.

c. Recommendations.

(1) The Army should recognize the presence of estimating bias and uncertainty in the establishment of the design-to-cost goals. A way must be found to improve these estimates if the DTC concept is to succeed.

(2) If the process of management by cost objective is to be successful, the Army must support its program managers with the authority and the flexibility to make the day-to-day schedule, performance, and cost tradeoffs required. Given such authority, program managers should then be held accountable for the ultimate outcome of their decisions.

C. DISCUSSION OF MAJOR ISSUES.

1. Costing Capability.

a. Issue. The ability of the Army to prepare accurate cost estimates has been seriously questioned. While the basic capability to prepare cost estimates was found to be better than generally thought, there are some fundamental managerial problems associated with the way in which the process is conducted.

b. Discussion.

(1) The organization for cost management in the Army has evolved such that all echelons are involved in the function. Figure IV -1 shows our view of the flow of project generated baseline cost estimates and independent cost estimates for major systems. The various agencies outside of AMC which use these cost estimates in their own work (for example, TRADOC and CAA will use cost estimates in the Cost and Operational Effectiveness Analyses) are not shown on this figure. It must be noted that this figure gives the impression of a degree of order which does not in fact exist. Each cost analyst has his own view of how the process really works. Bringing uniformity to this process is a policy area which should be addressed by the Army. A suggested policy statement is contained in Annex B.

(2) The Project estimates are developed by project cost analysts with the informal assistance of the Commodity Command's Cost Analysis Division, sometimes validated by them, and then briefed up through AMC and HQDA to the DSARC. The independent parametric cost estimate (IPCE) is made by analysts within the Commodity Command Comptroller channel and is staffed upward with review and approval at each echelon. This staffing process is effective in removing responsibility for the independent estimate from any one individual, while the Project Manager continues to be accountable for the baseline estimate as it is staffed to the DSARC. It also generates an adversary relationship among the cost analysts at the various staff levels. The predictable result is that the Project cost personnel appear to feel that they are part of the Project Manager's team while Comptroller cost personnel appear to view themselves as the "opposition", however loyal.

(3) The weapons system cost estimation/analysis function does not fit within the Army's practical definition of Comptrollership. Thus, the present costing capability is a highly specialized area which does not make a significant or appropriate contribution to the weapons

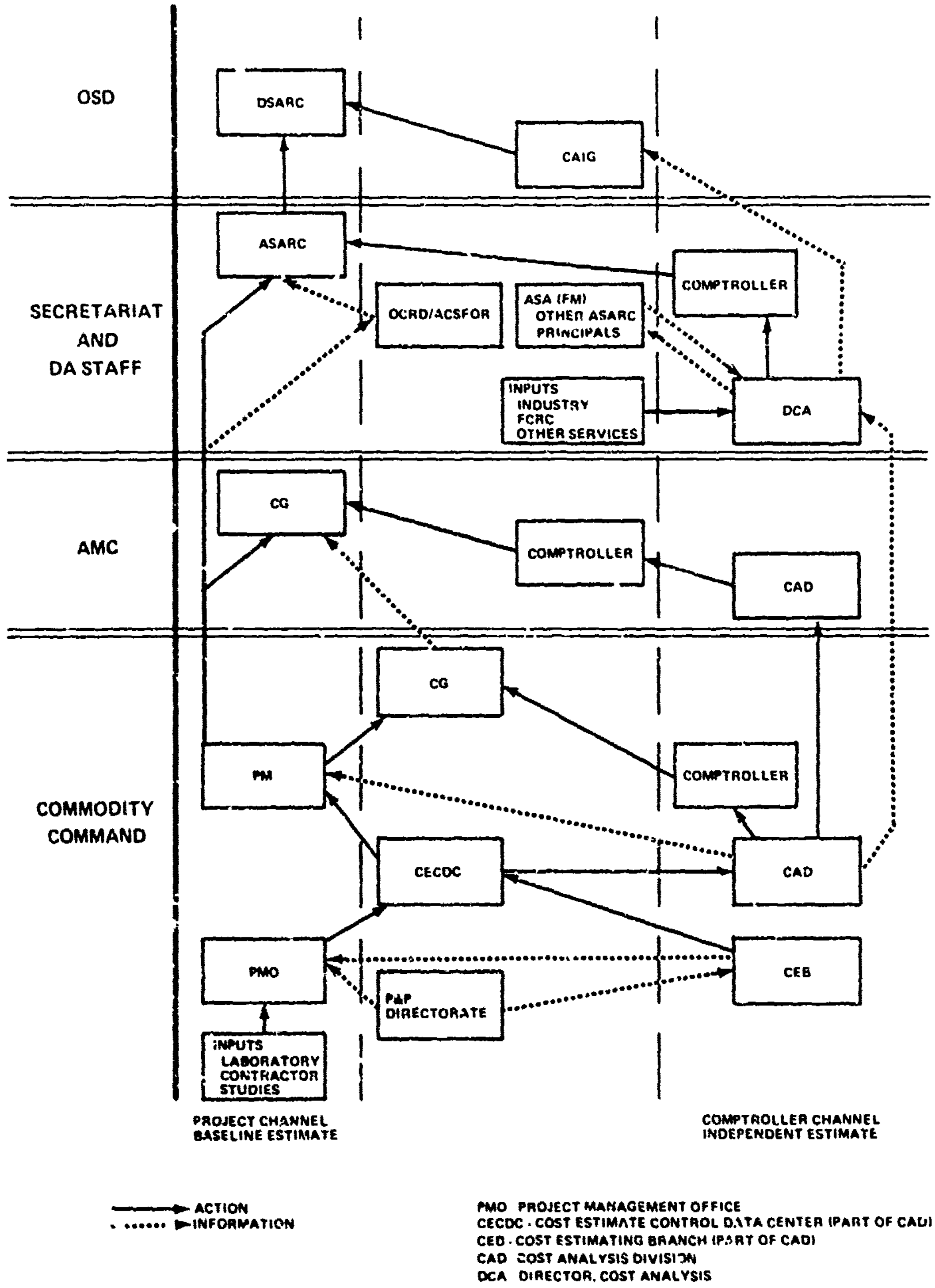


FIGURE IV-1 WEAPONS SYSTEM COST ESTIMATING

system acquisition decision making process. Most analysts at the Commodity Commands object to being placed in what is basically a finance and accounting organization which neither understands nor is interested in their business, and which offers the cost analyst no career progression. On the other hand most, but not all, Commodity Command Comptrollers would like to retain the cost analysts, usually with the justification of: Where else would you put them? This same general feeling also exists from AMC through DA. Because of the current mismatch between comptroller and costing functions, the cost analysis capability should be removed from Comptroller channels and realigned in a position where it can remain free from project influence, yet have enough stature to bring costing to the forefront of the decision-making process.

(4) At the Commodity Commands, the weapons system cost estimating capability should be removed from the comptroller channels and placed in a small central office which reports directly to the Deputy Commanding General. Its purpose would be to prepare, maintain and modify the Command's cost estimates.

(5) When we investigate the weapons system acquisition process above the Commodity Commands we find that there are two major focal points. These are the Commanding General of AMC and the Chief of Staff/Secretary of the Army. Therefore it is these two decision makers who have the principal responsibility for resolving any program ambiguities, including those of cost. In order to assist this resolution process the decision makers must have access to an independent cost estimate against which to evaluate the reasonableness of the Project Manager's baseline estimate. Seeing both of these estimates should provide a better perspective on the relative military worth of a system and permit sounder and more stable decisions on system development. We concluded that the independent cost estimates are of such importance to the acquisition of major systems that they require special procedures to guarantee that they will receive the management attention they deserve. This can be done by establishing weapons system cost analysis as a separate and distinct capability. not co-mingled with other important functions, and reporting as close to the two decision makers as possible. This would be the Deputy Commanding General in AMC and the Vice Chief of Staff at HQDA. It is understood that removing the weapons system cost analysis capability from a comptroller organization should not strip the organization of its capability to do the other types of cost analysis required by the remaining comptroller duties.

(6) The ill-defined progression of cost estimates is further

compounded by the manner in which estimates are done. There is no such thing as a simple cost estimate. The process starts with a relatively detailed estimate being done over a reasonable length of time during the early phases of a new weapons system. As the decision point approaches, the number of estimates to accommodate the "what ifs" rises dramatically while the amount of time available for each estimate decreases equally dramatically. Table IV-1 documents this phenomenon for the SHORAD (Short Range Air Defense) weapon system. The institutional downward bias is a prime driver of this in that it causes lower, and more frequent, estimates by indirection. The system is too sophisticated to simply direct that an estimate be lowered. Rather, a series of guidance or clues are given to subordinate levels, the net result of which is to cause a lower cost estimate.

(7) The highly subjective area of personal incentives is important. The immediate perception of cost personnel is that there are either no incentives or negative incentives in the system. Upon reflection, about 50% of those interviewed could generate a positive incentive, most usually pride in doing good work or the opportunity to make a high level briefing with its resultant exposure. Because of a recent tendency for AMC and OCA to make estimates and present the briefings this last reason may soon disappear.

(8) It may be possible to create more incentives for cost analysts by giving them job protection during adverse personnel actions. For example, job descriptions could be written such that marginally qualified people could not bump into cost analyst slots. This, however, is a two-edged sword since narrowly written job descriptions can act to reduce a manager's operating flexibility and may be a disservice to the individual by denying him career progression in reasonably aligned fields.

(9) Another incentive may exist for some analysts in the Commodity Commands since it is they who do that early cost work before a concept becomes a system. They may have an opportunity to transfer into the new Project Office, usually with a promotion.

(10) It is this slow but steady procession of personnel from Commodity Command to Project Office that appears to make the most significant contribution to the professional development of the costing community. After an analyst has attended one or more of the several costing courses which are offered by the Army school system he builds upon this theoretical base by practical application on the job. The most critical aspect of this is becoming trusted by the project personnel. This process is enhanced when the Commodity Command cost group "seeds" the project with one of its personnel. It is a strength of the

TABLE IV-1
SHORAD COST ESTIMATES

TASK INITIATION	DESCRIPTION	SUSPENSE
24 Sep 73	Orignial Task: ROLAND II, RAPIER/BLINDFIRE, CROTALE and CHAPARRAL IV-A(81 month alternative)	15 Oct 73
12 Oct 73	Recost 81 month schedule and do LCC for 54 month alternative (later revised to 57 month)	ASAP
23 Oct 73	Develop LCC for 51 month and 66 month alternative on all systems	9 Nov 73
29 Oct-2 Nov 73	Develop MACRO Cost for eleven alternate programs	ASAP
7 Nov 73	Recost all RAPIER on 12 firing unit per firing battery configuration	ASAP
19 Nov 73	Recost all alternatives without break in production	25 Nov 73
3 Dec 73	Provide cost analysts to prepare CAIG briefing	12 Dec 73
3 Dec 73-1500 hrs.	Provide rationale concerning Annual Procurement Quantity and Production Rate.	5 Dec 73-1530 hrs.
3 Dec 73-1500 hrs.	Assist in Cost of planned and manadatory changes.	5 Dec 73-1530 hrs.
3 Dec 73-1500 hrs.	Develop MACRO Cost - CROTALE 81 month and 66 month alternative with \$100 M PEMA constraint.	5 Dec 73-1530 hrs.
3 Dec 73-1500 hrs.	Cost GOER versus M109-ROLAND Vehicle.	5 Dec 73-1530 hrs.

TABLE IV-I (Continued)

TASK INITIATION	DESCRIPTION	SUSPENSE
3 Dec 73 -1500 hrs.	Provide $35M constraint analysis for FY 75 RDT&E.	4 Dec 73-1000 hrs.
3 Dec 73-1500 hrs.	Develop detailed LCC for PEMA $100M per FY constraint for 70 & 51 month alternative	5 Dec 73-1530 hrs.
3 Dec 73-1500 hrs.	Recost all alternatives due to acquisition schedule change	5 Dec 73 - 1530 hrs.
4 Dec 73-1000 hrs.	Recost all alternatives due to DT/OT quantity changes	5 Dec 73-1530 hrs.
6 Dec 73-1100 hrs.	Provide additional detail for 70 & 51 month $100M constraint.	6 Dec 73
6 Dec 73-1000 hrs.	Develop LCC for Chaparral II - with 17 batteries of 20 firing units	14 Dec 73
26 Dec 73	Develop new financial plans using new escalation indices	8 Jan 74

system and a credit to the maturity of the Commodity Command cost managers that they realize what is happening and still encourage this process which siphons off their good assets. The result is good rapport and communication between the Project Office and Commodity Command cost groups. On the other hand, this same level of communication does not appear to extend upward through AMC, OCA, and OSD.

(11) Even with the service schools which now exist (Army Logistics Management Center, Fort Lee and Army Management Engineering Training Agency, Rock Island) there is a need for additional formal education of cost analysts. One logical approach to the training problem is to start with an assessment of those skills which costing personnel at various levels and organizational echelons should possess. An inventory of skills on hand could then be conducted. The difference between these two assessments will define the nature of additional training courses required.

(12) The sum of these considerations coupled with the quality of the data base determines the accuracy with which cost estimating can be done. Historical data on the costs and characteristics, both performance and physical, provide the basis upon which costs of prospective systems are estimated. This is true for estimates prepared by the industrial engineering (bottoms-up) approach, and for those prepared at a higher level of aggregation using parametric techniques. The Army does not have the data necessary to prepare engineering estimates; that data base is held by defense contractors, as perhaps it should be. The Army does have a data base that is used to estimate costs parametrically. This data base has been compiled for a number of system types (e.g., missiles, helicopters, tanks, etc.) as needed to prepare specific estimates. A comparison of "actual" data reported by various people in the Commodity Commands, in the Army Materiel Command, the Department of the Army, and the Office of the Secretary of Defense reveals significant differences among those sources on both cost and characteristic data. An expected characteristic of these data bases is that their accuracy tends to decline as one goes to higher organizational levels. It is observations such as this which lead us to conclude that the overall quality of the data base is often poor. However, it should be noted that significant steps are being taken in some commodity commands to improve data base quality.

(13) Because of the instability of Army requirements, it is virtually impossible to track a number of estimates through the development process with any quantitative certainty. There are, however, a series of qualitative statements that can be made about accuracy:

(a) The Government Accounting Office (GAO) reports that cost estimation inaccuracies account for approximately 25% of cost growth.

(b) The consensus of those interviewed is that their R&D estimates at the time of DSARC I are on the order of ±20% accuracy and production estimates at DSARC III are about ±10%.

(c) A major U. S. corporation claims procedural advances which allow 10% accuracy on R&D proposals.

(d) A review of estimated versus currently projected costs for five selected Army systems, when requirements changes are subjectively discounted, indicates an IPCE accuracy in R&D of 10% over a four-year period compared to a project variance of 33% for the same period. Extrapolating this to accommodate an eight year development cycle yields an IPCE accuracy on the order of ±20%. Figures IV-2 and IV-3 show details for two of these systems. In the case of TACFIRE (Tactical Fire Direction System) (Figure IV-2) the early independent estimate was actually lower than the project figure. The more recent independent estimates have been higher than project estimates and the trend is toward the higher figures. SAM-D (Figure IV-3) is a case where the Army reprogrammed funds to remain consistent with the IPCEs. Even though the project estimate of cost was lower than the IPCE the Army carried the IPCE value in all official program documents and SARs.

Thus, it is clear that unless the cost practitioners are grossly deluded, independent cost estimation accuracy is not the prime contributor to the over 100% cost growth cases which have occurred.

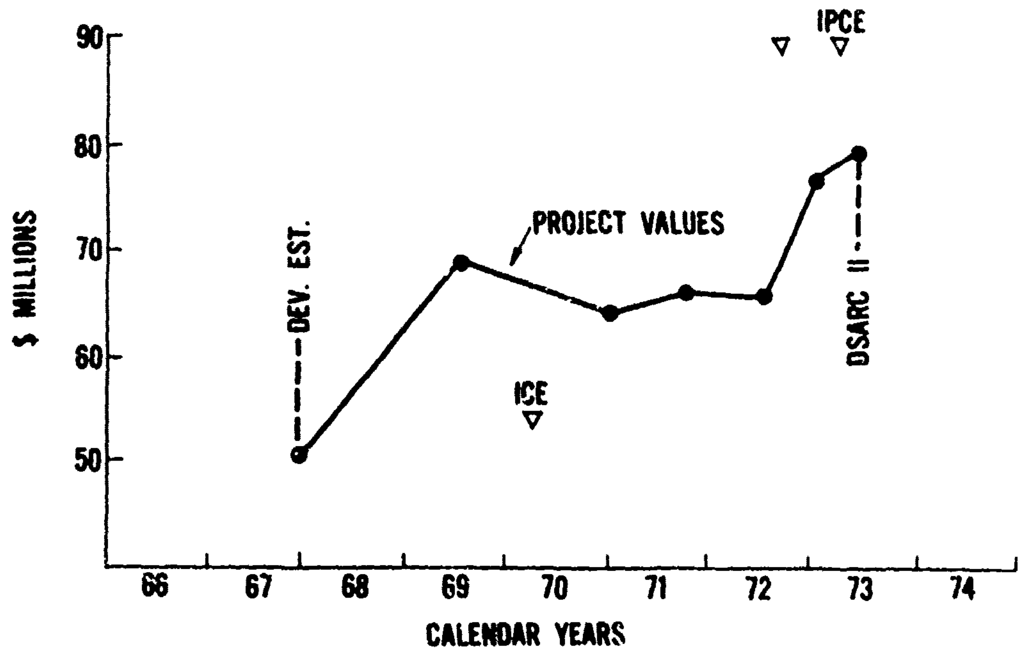


FIGURE IV-2 TACFIRE R&D COST HISTORY

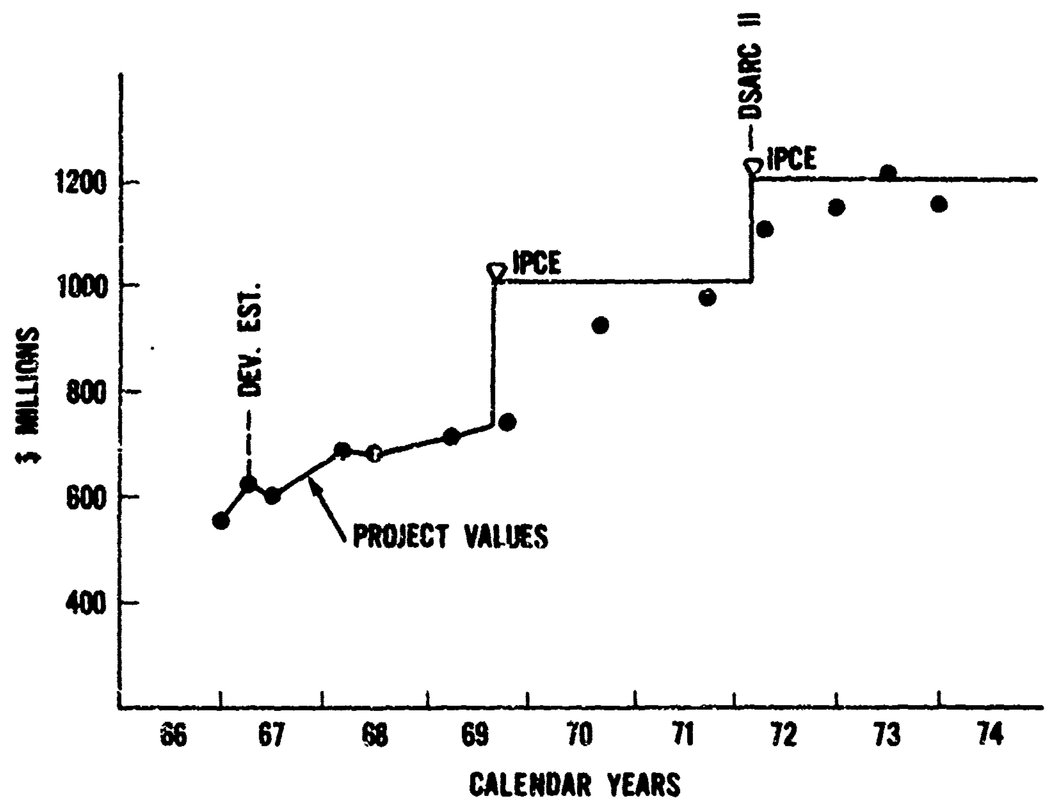


FIGURE IV-3 SAM-D R&D COST HISTORY

(14) The team noted many improvements which the Commodity Commands are making in their costing capability. These improvements include such things as data base gathering, refined analytical techniques, computer costing routines and internal cost estimating classes. Such improvements applied across all the Commands could have the effect of raising AMC's costing capability to a uniform and consistently high level.

c. Recommendations.

(1) The Army should publish a general policy statement which establishes guidelines concerning the responsibilities of various organizations for the generation and flow of baseline and independent cost estimates. A recommended statement of detailed policies and procedures is presented in Annex B to this report. In brief, this requires the independent cost estimate prepared at the Commodity Command to be identified, to be reviewed but not changed at higher echelons (except in response to altered project content), and to be processed parallel to the Project Manager's baseline cost estimate.

(2) The weapons system costing function should be removed from the Comptroller channel at all levels. At the Commodity Commands and AMC it should be established as a separate office reporting directly to the Deputy Commanding General. In DA Headquarters it should be established as a separate office reporting to the Vice Chief of Staff.

(3) The Army should undertake a priority program (in coordination with the other services and OSD) to validate data collected previously and to collect and validate data on additional systems in anticipation of recurring cost analysis needs for accurate historical data on defense systems. This recommendation must be administered with caution since such an effort, while productive at a command which has relatively few large systems (e.g. MICOM and TACOM), might not be productive at a command with relatively many small systems (e.g. ECOM). It must also be assessed at each command to determine if additional resources will be required.

(4) For those systems now being acquired by the Army, an individual in the Commodity Command concerned should be assigned responsibility for compiling and documenting data on system physical and performance characteristics, costs, schedules, and milestones paying particular attention to evolutionary changes and their real causes. The same caution as above applies.

(5) Both the professionalism and incentives of cost analysts should be improved by requiring a cultural change on the part of high level managers such that they recognize costing personnel as valuable

team members and provide a proper environment for their professional advancement. They should be included as active participants of Source Selection Evaluation Boards.

2. Downward Bias In Cost Estimating.

a. Issue. In addition to uncertainties associated with unexpected economic conditions, technical difficulties, and program changes, a downward estimating bias in the preparation and processing of major weapon system cost estimates can degrade the overall cost estimating quality. This downward bias stems from conscious or unconscious attempts to optimistically portray the expected program outcome and incurred costs.

b. Discussion.

(1) The Team found that there were pressures during each phase of the weapons acquisition process and at each step in the cost estimating process which tended to produce a downward bias in the final approved program cost estimate.

(2) Program advocacy produces downward bias in the early planning stages, during development, and well into the production phase as the requirement to sell the program among competing projects for limited acquisition funds becomes a major factor in the weapons decision process. Optimistic program planning based upon success-oriented technology development adds to the downward bias prior to DSARC III while assumptions of optimum production processes and schedules, rarely achieved in practice, produce unrealistic production cost estimates for post-DSARC III programs. Biased government estimates are subsequently supported and sustained by the competitive marketplace where the penalties for over-optimistic estimates are not adequate to deter their use.

(3) An example of the contributing influence of estimating bias can be visualized in an analysis of 16 major weapon systems' cost growth during the development process. As illustrated in Figure IV-4, the expected value of all planning estimates analyzed yields a mean estimate uncertainty of 155 percent at DSARC I and 125 percent at DSARC II. Unfortunately the contribution of bias to the aggregate estimate uncertainty is buried together with the effects of estimating errors and unforeseen economic changes.

(4) Downward bias pressures were found to exist during each step of the estimating process for major weapon systems. Estimates prepared by program offices are advocacy estimates, and to the extent that major new programs represent a sizable portion of a commodity command's activities, commodity command estimates can also be subject to advocacy bias. As estimates proceed from the commodity

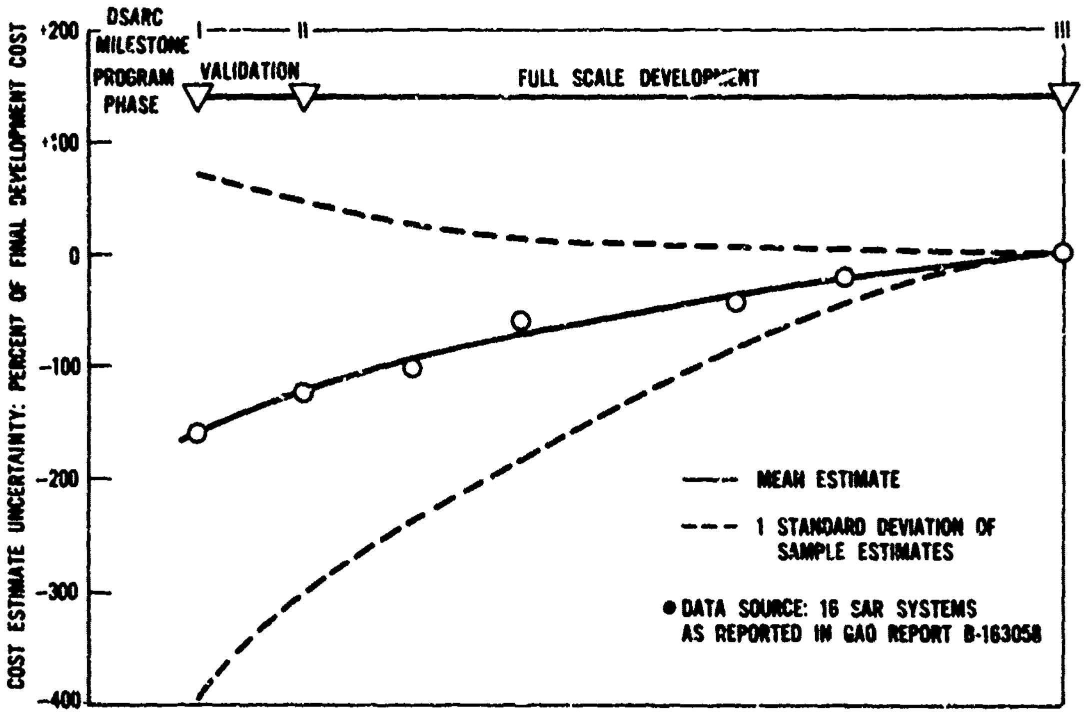


FIGURE IV-4 COST ESTIMATING UNCERTAINTY DURING WEAPON SYSTEM DEVELOPMENT

commands through AMC Headquarters and on to higher headquarters at the ASARC/DSARC levels, the reflection of fixed budgetary thresholds and program budget constraints exerts a strong pressure for conformity. The response to non-conformity is, in most cases, a reestimation of a slightly altered or less ambitious program without the benefit of the tools or the time schedule that was available for the initial estimate. In some cases the estimates have been changed by directions that analysts change or even delete certain input variables. Consequently, the final program estimate is often a product of hastily-prepared alterations to a detailed estimate all of which incorporate subjective downward bias.

(5) One of the principal reasons that program optimism and advocacy bias persist in the cost estimates is the difficulty presented in substantiating an estimate containing contingency factors or allowances for problems encountered on similar previous programs. Estimates based upon programs where technical or managerial problems resulted in higher than estimated costs are vulnerable to the implication that the acquisition learning curve is flat and that past mistakes and problems will reoccur. Much of this estimating difficulty could be identified for debate by incorporating uncertainty bands about the baseline cost estimates for the major systems. Revisions to the estimate would therefore include revisions to the uncertainty bandwidths as the acquisition process proceeds through development and into production.

(6) We found that, in the absence of program or institutional bias, many of the Army's cost estimating organizations which had a sufficient data base could prepare credible estimates of expected weapon program costs. The best estimating capability generally resided at the commodity commands where detailed cost data on past programs and contractor performance was available. It is believed that good program cost estimates which can be improved as the program progresses through the acquisition cycle are possible for many Army programs utilizing the data and tools presently available. The challenge to Army management is the preservation of the estimate's integrity as the pressures for advocacy and budgetary conformity mount.

(7) One promising approach to the control of bias pressures during the estimating process is the generation of independent parametric cost estimates (IPCE's). In the past, these estimates have usually been prepared by organizations and task forces outside of the program office in order to reduce bias. Table IV-2 illustrates the results of recent efforts to prepare IPCE's by AMC cost analysts. It is significant that, for virtually all seven systems analyzed, the independent estimates are closer to the present program estimate than that predicted by the orginal program estimate.

SYSTEM	CY 1972	CY 1973		% DIFFERENCE THEN	% DIFFERENCE NOW
SAM-D			R&D	+19	0
			PROC	+28	0
STINGER			R&D	+18	0
			PROC	+1	+1
DRAGON			R&D	SUNK	SUNK
			PROC	+17	+12
UTTAS			R&D	+10	+3
			PROC	+2	+3
TACFIRE			R&D	+23	+7
			PROC	+42	+24
PERSHING II			R&D	+8	+5
			PROC	+11	+11
MICV			R&D	+29	+13
			PROC	+13	+6

TABLE IV-2 INDEPENDENT PARAMETRIC COST ESTIMATES (IPCE's) RECORD

(8) Estimating methodologies used for the IPCE's are usually based upon a combination of parametric and analogy approaches and often were seen to incorporate all available techniques to form an opportunistic or eclectic estimate. Until independent or "unbiased" organizations charged with preparing IPCE's can establish an appropriate data base and estimating methodology, the uncertainties surrounding these estimates will remain a major weakness which can easily mask the process of advocacy bias in the baseline estimate.

(9) Downward bias in estimated costs is also often the result of optimistic scheduling without contingency plans for product development and production problems. Recent studies by the General Accounting Office and others have illustrated that schedule growth occurs for many of the same reasons as cost growth, including advocacy bias, and that average schedule growths between 30 percent and 60 percent were measured on major weapons acquisition programs. In a manner analogous to cost bias to meet budgetary constraints, program schedules are often "determined" rather than "estimated", leading to program pressures for conformity despite large areas of recognized schedule risk.

(10) Good cost management implies not only sound cost estimating but also the corresponding execution of the project within the forecast cost. Since project management's many decisions during planning and actions during execution are prime determinants of what the system ultimately will turn out to cost, it is important, insofar as possible, to get the project manager personally committed to bring the project in for his estimated cost, and to get the agency committed to leaving him on the project until the results are in. The Army's practice of high rates of rotation seriously degrades the PM's capability as well as his effectiveness in managing a professional team that is largely civilian. Until the Army decides to increase project management tenure and future accountability it will continue to make a decision by default to not do materiel acquisition as well as it can be done.

(11). Depending upon the degree of personal commitment obtained, the sufficiency of tenure of the project managers, and the credibility of the agency's subsequent actions vis-a-vis successful and unsuccessful managers and programs, the foregoing can operate as a strong driver toward realistic cost estimates to counter the strong downward-driving tendency of the desire to sell programs.

c. Recommendations.

(1) The Army should take the necessary steps to emphasize the necessity of establishing a highly visible baseline cost estimate which

will remain with the project throughout the review cycle and the subsequent acquisition process. The baseline estimate, with detailed updated estimates resulting from project changes, should result in a complete cost estimating history for the program.

(2) The uncertainty associated with estimating costs should be recognized and quantified in both baseline and independent cost estimates for all major weapon systems. Estimates incorporating optimistic and pessimistic values together with expected values of program costs should be visible through ASARC/DSARC decision levels.

(3) The Army should support the preparation and recognition of independent cost estimates. The independent estimate should augment the baseline estimate by providing additional information and by refining the baseline cost estimating uncertainty bandwidth through the use of alternate estimating methodologies when appropriate. The independent estimate, like the baseline estimate, should remain with the project, with appropriate updating resulting from changes, throughout the program.

(4) The Army should adopt a policy of leaving project managers on the job until the completion of a life cycle phase in order to establish greater costing accountability.

(5) A Project Manager's performance appraisal at the conclusion of his assignment should assess and reflect his accountability for cost management.

(6) Schedule estimating efforts should be linked to cost estimating efforts to emphasize their interrelationships and to provide for an expanded data base from past experience. Do not overlook the impact of program actions on schedule and manpower loading, as well as on program costs.

3. The "Buy-In" Problem.

a. Issue. In an effort to win competitions, contractors often propose costs that are unrealistically low in relation to the work to be done. This either results in apparent cost growth or in the work being shorted, or both.

b. Discussion.

(1) "Buying in" is a mechanism distinct from "downward bias" (though both may operate in a given case). Downward bias is the desire, conscious or otherwise, on the part of either agency, contractor, or both, to look optimistically at costs so as better to sell a program (to OMB, Congress etc.). Buying in is a contractor strategy of proposing an unrealistically low cost in order to win a competition.

(2) The toughest buy-in problem revolves around cost-reimbursement type contracts for development. The cost to develop something new cannot be forecast accurately, which is why the cost-reimbursable contract is used. The contractor's cost proposal is necessarily an estimate and implies no guarantee of doing the job within that figure.

(3) As long as the world-at-large (including Congress, the press, the public, various self-appointed experts, and, to some degree, even the GAO) remains as it is, very few outside people are going to understand cost-reimbursable development work. They are inevitably going to attach undue significance to the proposal numbers that seem to show how much the various competitors "were willing to do the job for." Thus if a contractor proposes a low figure and loses, or fears he might lose, he can put up quite a smoke screen by claiming to be the "low bidder". The fact that he has not committed to complete the work within such a figure usually is not comprehended.

(4) In this circumstance, proposing a low figure is a handy (and not really very costly) way for a contractor to prepare to focus external pressure on an agency during and after the source selection process. If then the agency's source selection processes do not make appropriate and operable provision for the selection to be made on factors other than proposed cost, the temptation to buy in becomes almost irresistible.

(5) A danger when contracts are negotiated at too low a price is that an adversary relationship is created on both sides, and both parties lose sight of the objective, which is to provide the Army

with a product which will fully meet its requirements. The basic way to work against buying-in tendencies is to try to make the buying-in maneuver as ineffective as possible as a way to win competitions. The suggestions listed below are some things that can help resist the buy-in syndrome in development phase contracting:

(a) Make it plain and make it publicly known that source boards are to consider, under the cost category, what it is thought it will actually cost the government in the event they choose contractor A, B, or C to do the job. These may differ substantially from what they proposed. Give credit in proposal evaluation for sound and substantiated cost estimating.

(b) Do not negotiate cost-reimbursable R&D contracts with proposers prior to selection, because:

1. Negotiating inevitably brings a degree of transfusion or injection of ideas, or in any event a greater degree of similarity of the proposals, one to another. This "leveling" effect makes it more difficult to choose on the basis of relative excellence and more difficult not to choose on the basis of alleged price.

2. Negotiating furnishes the proposed cost figures with an apparent credibility that they do not deserve.

3. (Incidentally), avoiding multiple negotiations saves a lot of work and time.

(c) Do not permit an RFP to be issued until the evaluation criteria have been reviewed by the responsible management of the project. See that the RFP asks for what is wanted and doesn't in itself encourage a buy-in. See that the evaluation criteria do not contravene this.

(d) Indicate clearly in debriefings and source selection statements when selections occur in which the low proposer is not selected.

(e) For some development programs it may be useful to engage in a fixed price procurement while varying performance.

(6) It still may be that proposed figures coming in for a competition appear much too low. If this happens, here are some suggestions as to how to proceed:

(a) Remember that the whole purpose of the exercise is to choose so that the government's work gets done best, and choose accordingly.

(b) Do not negotiate a winner up to the government's idea of cost if he happens also to have made what is thought to be an unduly low cost proposal.

(c) Keep funds in the program to cover what the Government thinks the cost will be, and do not adhere to the contracted figure. Usually, the program and budget figures encompass more than any one contract covers, and program cost can be viewed as a whole. If the government does not think that the contractor can meet his contract costs, then appropriate adjustments should be made that keep costs low but do not jeopardize development. The curious practice of publicly stating that it is very unlikely that the contractor can meet his cost number, programming a higher number, but instructing the PM that the contractor must meet the contract number introduces practices on both sides that will seriously harm the program.

(d) In the course of development, the government should, by the exercise of its own expertise, insure that the low contracted figure is not causing the development to suffer. If upward changes are necessary, they should be made. The government agency has to be sure that it has the expertise to do this, otherwise it shouldn't be allowed to manage development work.

c. Recommendations.

(1) The agency should make sure that sufficient funds to conduct development properly are programmed. In the event that a contractor has proposed and contracted for too low a figure, and there is danger of bona fide development work being shorted as a result, appropriate changes should be negotiated. In a development program, by definition, not all issues can be anticipated. Thus, sequential decision making is required.

(2) A resolute attempt should be made to prevent successful buy-in maneuvers. In the evaluation of proposals, credit should be given for sound and substantiated cost estimating. Source selection boards should consider what actual costs will likely turn out to be for each of the several proposers. Cost-type development contracts should be negotiated after selection rather than before to avoid leveling and to reduce the tendency toward unsound cost proposing.

4. Life Cycle Costing.

a. Issue. The need for and the definition and conduct of life cycle cost (LCC) analyses are less than clear to DOD personnel. In any event, the capability to estimate the annual recurring operations and maintenance (O&M) costs, both direct and indirect, is doubtful. However, life cycle cost estimating should be addressed if future cost impacts of weapon system ownership are to be considered. Acquisition and operation of weapon systems under peacetime budget constraints means that full costs of ownership are becoming major determinants of force composition and defense capability.

b. Discussion.

(1) The definition of "Life Cycle Cost" varies among those interviewed. Some think LCC is synonomous with total systems cost, i.e., all costs necessary to develop, procure, operate and maintain a system throughout its useful life. Some think LCC places emphasis on the costs to operate and maintain the system. One drew a technical distinction between LCC and total systems cost: the former should account in detail for the expected life-time of components within the system while the latter permits one to approximate costs based on an assumed 10-year life for the system as a whole.

(2) Given the confusion existing over its definition, the need for LCC was equally unclear. Some thought that LCC should be presented to the DSARC, but hastened to add that we could not do a credible job. Some thought that the uncertainty associated with projections made 15 to 20 years in the future mitigated against its usefulness. Others thought it quite important to use LCC to insure that tradeoffs among development, procurement and O&M costs are made, and that those trade offs be presented at all DSARCS. Some thought that LCC should be estimated so that the Extended Planning Annex (for the period ten years beyond the FYDP) would more accurately reflect the future budgetary impact of decisions to acquire systems today.

(3) Still others thought its primary usefulness to be in the analysis of alternatives, whether the alternatives involve a decision on, for example, land-based versus sea-based strategic deterrents or whether it involves the design and production of a tire such that the present value of the sum of acquisition plus O&M costs is minimized. The latter type of analysis has been encouraged by the Defense Economic Analysis Council (DEAC), and directives have been issued for its conduct. The former type of analysis is exemplified by those cost-effectiveness

studies conducted by the Concepts Analysis Agency prior to the selection of a major concept designed to meet a given threat.[2]

(4) It is possible to prepare LCC estimates only when their context is clearly known. The context defines those costs that are relevant and those that are not. For example, sunk costs must be identified because they should not be counted. Support costs must be counted and are most difficult to identify even when the specific context is known. A basic understanding of how support costs vary with changes to the Army's force structure must be obtained. The arbitrary allocation of those costs, as is sometimes necessary for accounting purposes, can be grossly misleading for analytical purposes.

(5) Life cycle cost estimating has been a topic of concern to the Army and the DOD for a number of years. Policy and procedural guidance for considering the life cycle costs of major weapon systems has been promulgated and efforts to estimate life cycle costs have been pursued in the Army. However, despite these initiatives, little solid progress in incorporating life cycle cost considerations in the weapons acquisition decision process was visible to the AMARC costing team. In fact, LCC rarely entered our discussions except when raised by us.

(6) Reasons for the failure of life cycle cost estimating to play a role in the acquisition process involve the difficulties encountered in providing detailed or precise estimates of operations and maintenance costs, the difficulties encountered in measurement of these costs, and the rotational management assignment process which discourages serious consideration of future cost implications because those responsible for operations cost decisions will be gone when the results can be identified and measured.

---

[2]The techniques of engineering-economic analysis are well understood and taught as an integral part of the Industrial Engineering curriculum of most major universities. The methods of cost-benefit and cost-effectiveness analysis are now taught in many universities. In practice, however, we find that "good" estimates of benefits or effectiveness on the one hand, and costs on the other, defy simplistic approaches and require much time-consuming and laborious effort. In general, too much time is devoted to academic discussions of method (e.g. the appropriateness of discounting future costs and benefits, and at what rate) and too little to the difficult tasks of deriving good estimates to be used as inputs to our carefully thought-out-models.

(7) Data collection systems have been designed and implemented to obtain maintenance man-hours and parts consumption at all maintenance echelons within the Army. The reliability of the data has been questioned ad nauseum; "the mechanic is a poor record keeper." A less expensive and perhaps more reliable substitute for extensive maintenance activity reporting is a sampling scheme designed to have representative data collected by people trained to collect data. This should be given careful consideration by those seeking responsive action to Mr. Clements' memo of 25 January 1974, "Visibility and Management of Support Costs." In any event, sampling may be used to determine the accuracy of maintenance activity reports.

(8) Recognizing the real problems attending the estimation and measurement of life cycle costs, we nevertheless believe that full operational costs must be considered an indispensible ingredient of the acquisition decision process. The attempt must be made to assess the operational cost implications during the critical development period[3] and these costs must be made to influence the ultimate design. Of particular importance are the man-machine trade-offs that must be made to reduce the ever-increasing burden of manpower costs.

c. Recommendations.

(1) The Army should seek innovative ways to support strongly Mr. Clements' Directive of 25 January 1974 on "Visibility and Management of Support Costs." The effort is basic to improving the Army's ability to estimate O&M costs, both direct and indirect.

(2) Top management in the Army should question how and at what cost their new systems will be maintained during their operational lifetimes. For example, they must insure that designs to reduce acquisition costs do not increase O&M costs by more than the hoped for saving or that increases in acquisition costs are more than offset by O&M cost savings.

(3) Life cycle cost estimates, and the rationale for their generation, should be included in all major weapons acquisition decision processes such as ASARC and DSARC, even if they are only of "order of magnitude" quality initially.

[3] That period in development when important tradeoffs are made in establishment of the system's design.

(4) The Army should, on a continuing basis, assess future O&M costs during the critical development period of a weapon system in order to influence the ultimate design toward optimized cost of ownership, performance, and operational availability.

(5) In order to improve the quality of the data base, the Army should pursue sampling techniques as a potential substitute for widespread maintenance cost reporting, or alternatively, as a means for determining accuracy of reported data.

5. <u>Cost Estimating for Design-To-Cost.</u>

a. <u>Issue.</u> The design-to-cost (DTC) acquisition philosophy as it is presently being applied by the Army has resulted in unit production cost targets directed at controlling unit costs during volume production. The success of this management concept is critically dependent upon the DA and supporting contractor abilities to estimate a realistic future production cost and the PM's freedom to make adjustments to meet it.

b. <u>Discussion.</u>

(1) The design-to-cost (DTC) concept for weapon system acquisition is a key part of the overall DOD effort to reduce the costs and improve the management of the major systems. We found that the Army was vigorously embracing the DTC philosophy for weapons acquisition and had moved ahead toward implementing the concept through policy directives, guidance documentation, and contractual commitments. While the concept has yet to be fully proven in practice, the Army appears to be off to a strong start.

(2) The employment of the DTC concept in the major weapons systems slated for DSARC review has surfaced a number of problems associated with establishment of the design-to-cost goal and the management of the cost-schedule-performance tradeoff at the program management level. The difficulties inherent in estimating the cost goal relate to the issues already discussed: the costing capability, the presence of downward bias, the problem of contract "buy-ins", and life-cycle cost implications. Given these problems, the program manager must manage a DTC program bounded by time and performance constraints as depicted in Figure IV-5. The figure assumes a firm DTC goal and some given performance level and schedule. If a breakthrough should occur, then for the same DTC figure, performance would increase and schedule shorten. Thus, the firm DTC goal indicator would move up and to the left. Conversely,

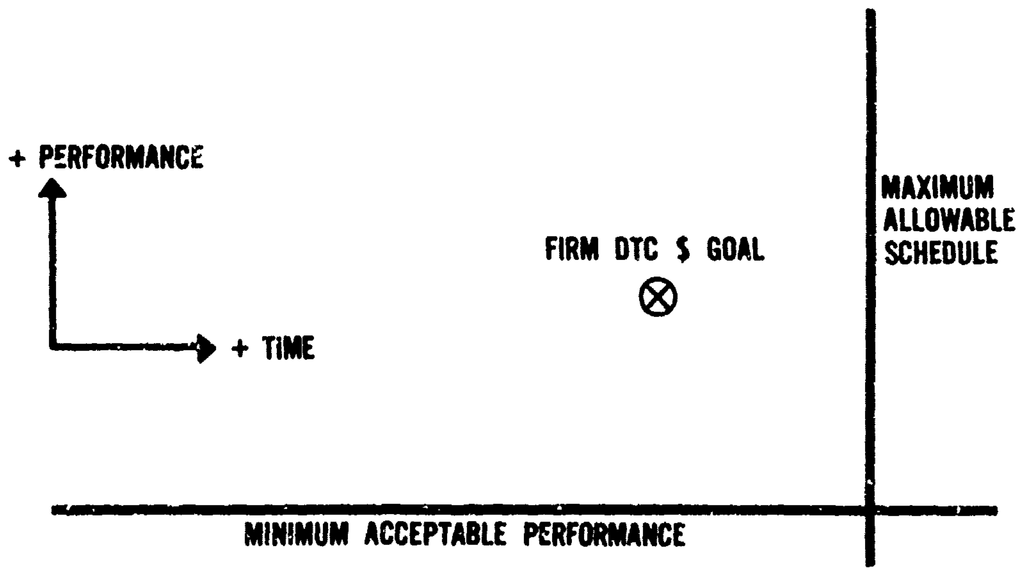


FIGURE IV-5 PERFORMANCE AND SCHEDULE FLEXIBILITY FOR A FIRM DTC GOAL

if the program should encounter technical difficulties, performance would decrease and schedule lengthen, again for the same DTC figure. In this case the indicator would move down and to the right. If the latter trend continues the project will violate either its performance or schedule constraints or both. The problems of downward bias and "buy-ins" which were operating when the current design-to-cost goals were established have led to the conclusion that some of these goals are understated. We may in the very near future find that there are project managers who have DTC goals which already place them very close to the time or performance constraints.

(3) In order for the contractor to be able to achieve the specified "design-to-cost", the government program manager must have sufficient flexibility in his direction of the project to be able to authorize certain variations in the schedule on which the work will be performed (e.g. specific milestones during the acquisition cycle, or the IOC date for the end product). Such variations should naturally be within certain specified ranges, which may be established in advance by the procuring authority, or perhaps negotiated as the program proceeds. Similarly, the performance requirements for the equipment must be subject to negotiation within certain allowable limits in the same way as the schedule. The significant point to be recognized in design to a cost contracting is that the acquisition cost is in fact a dependent function of performance, schedule, and quantity. If it is desired to maintain an agreed-to "design-to" cost, and the quantity to be acquired is presumably a firm number, then it is clear that the only two parameters which can be varied are performance and schedule.

(4) It is necessary to establish the firm design-to-cost at a point which will allow a certain amount of tradeoff between performance and schedule before either the minimum acceptable performance or the maximum allowable schedule is reached. If the firm dollar value objective is originally set at a point too near either the minimum acceptable performance or the maximum allowable schedule, the program manager will not have sufficient flexibility to trade off these two parameters in such a way as to meet the established design-to-cost while still maintaining the desired quantity to be procured, the allowable schedule, and acceptable performance for the purpose intended. It is clear that the program manager, having lost his flexibility to make the necessary tradeoffs, must abort the effort.

(5) Given the broad perspective of the costing team, a number of additional problems in the areas of cost estimating and program cost management which appear to be especially critical are:

(a) Establishment of the DTUPC.[4] Establishment of a realistic cost target or bogey for production which may occur as distant as six years in the future is still a major concern in DTC. Estimates of future production costs contain a great deal of uncertainty, such that the difference between optimistic and pessimistic estimates is often the key factor in deciding whether to proceed toward eventual weapon development.

(b) Competition in DTC. The management of a competitive procurement environment under a DTC program has presented new problems in areas of proposal evalution, price analysis, contractor tradeoff authority, and cost reporting requirements. The problem of the low bid, seemingly non-responsive, is also of concern.

(c) Cost Escalation Indices. Many of the DTUPC programs reviewed by the committee stated production cost targets in constant dollars for the year in which the estimate was constructed. Recent unstable estimates of price escalation by the government have raised concern by both the contractors and the program offices that, when production is reached in the future, serious disputes may arise over proper constant dollar deflation of current year costs.

(d) Production Learning Curve Estimates. Establishment of previous production learning curves or cost-quantity relationships and the negotiation of DTUPC contract learning curve values has been difficult because of the lack of uniform or comparable cost-quantity data, the impact of technology and capital investment in manufacturing plants, and the future uncertainties associated with plant capacity and productivity.

(e) The Administrative Costs of DTUPC Programs. Several contractors shared the view that DTUPC programs would entail greater administrative and financial management cost which would increase total program costs significantly. Except for a few systems, the Army procurement quantities are considered by commerical, product-oriented firms to be at uneconomical low levels for the degree of cost control desired by the Government.

(f) The Credibility of the DTUPC Concept. There still exists considerable Government and industry skepticism that the DTUPC concept can actually be implemented. This view stems from the recognition that cost growth on past major weapon systems has been caused predominantly by unexpected economic conditions or program/requirements changes. The former force costs up and the latter represent conscious choices by management to incur higher costs.

---

[4] DTUPC: Design To Unit Production Cost

(g) DTUPC "Lessons Learned" Feedback. There exists a general agreement within the Army that the DTUPC concept is still in the formative or experimental stage with success and failure modes still to be identified. Thus, as the Army already recognizes through the AMC DTUPC Guide, program documentation is of critical importance and feedback among projects as to what's right and what's wrong is essential for management education.

(h) Program Management Flexibility. While most program managers interviewed during the course of the study believed that they held both the requisite authority and responsibility to implement optimum design-to-cost tradeoffs required to hold the cost goal, most of the DTC programs are relatively young; opportunities for critical cost schedule-performance tradeoffs have yet to come.

c. Recommendations.

(1) The Army should recognize the presence of estimating bias and uncertainty in the establishment of the design-to-cost goals. A way must be found to improve these estimates if the DTC concept is to succeed.

(2) If the process of management-by cost objective is to be successful, the Army must support its program managers with the authority and the flexibility to make the day-to-day schedule, performance, and cost tradeoffs required. Given such authority, program managers should then be held accountable for the ultimate outcome of their decisions.

ANNEX A
PRINCIPAL INTERVIEWS, VISITS AND MEETINGS

1. Washington, D.C. Area

Mr. Margolis - Chief, Cost and Economic Analysis, ODDPA&E
Mr. Fredericksen - Assistant Director for Land Warfare, ODDR&E
Mr. Srull - Former Deputy Director for Resource Analysis (DDPA&E) and CAIG Chairman, ASD(MRA)
Mr. Gansler - Assistant Director for Planning, ODDR&E
Mr. Jarrett - CAIG Member, ASD(I&L)
Mr. Seidel - Chief, Cost Analysis Branch, DCA
Mr. Conley - Chief, Cost and Economic Analysis Division, USAF
Mr. Kammerer - Head, Resource Analysis Group, USN
Mr. Hobbs - Acting Deputy Assistant Secretary, ASA(FM)
Mr. Trainor - Director, Materiel Programs, OCSA
General Flanagan - Comptroller of the Army
Dr. Smith - Assistant Comptroller for Economic Policy and International Programs (Former Director of Army Cost Analysis), OCA
Mr. Allen - Director, Army Cost Analysis, OCA
Mr. Chavet - Chief, Materiel Analysis Division, OCA
Mr. Bassett - Cost Analyst, OCA
Mr. Tropf - Chief, Cost Analysis, AMC
Mr. Koletar - Acting Director, Methodology and Resources, CAA

Office, Management and Budget
General Accounting Office
National Aeronautics and Space Administration
Deputy Chief of Staff for Research and Development, USAF
Deputy Chief of Staff for Personnel, Department of Army
Army Materiel Command
Concepts Analysis Agency

2. Aviation Systems Command, St. Louis, MO

Mr. Laughlin + - Chief, Cost Analysis Division
Dr. Keenan - Deputy Director, P&P Directorate
General Cockerham + - PM, AAH
Mr. Busse + - Deputy PM, UTTAS

3. Missile Command, Redstone Arsenal, Huntsville, AL

General Ellis - CG
Mr. Norman + - Chief, Cost Analysis Division

Mr. Huie - Price Analyst, P&P Directorate
Mr. Wisner + - Chief, Program Management Office, STINGER
LTC Lustig + - Deputy Director, Program Management Division, SAM-D
Mr. Welch - Chief, Cost Reduction Office (SECRAC), SAM-D
Mr. Dobbins - Deputy PM, SHORAD
Mr. Charlton + - Deputy PM, HAWK

4. Electronics Command, Ft Monmouth, NJ

Mr. Ruzgis + - Chief, Cost Analysis Division

5. Tank Automotive Command, Detroit, MI

General Pieklik - CG
Mr. McGregor + Chief, Cost Analysis Division
General Baer - PM, XM-1
COL Sheridan + - PM, M-60
MAJ Welsh + - Project Coordinator, MICV

6. Army Logistics Management Center, Ft Lee, VA

US Army Procurement Research Office

+ Indicates other staff members were present

ANNEX B

SUGGESTED COST ESTIMATING POLICY STATEMENT

It is suggested that the following Letter of Instruction be signed and distributed in order to bring a degree of uniformity to the cost estimating process.

SUBJECT: Letter of Instruction for Cost Estimating

1. Purpose. To provide policy and procedures for cost estimates which support acquisition of major weapons systems.

2. Policy

a. All major weapons systems will have baseline and independent cost estimates prepared.

b. Baseline and independent estimates need not agree with one another. Differences must be understood but not resolved.

c. Independent estimates should be characterized by bands of expected cost rather than point estimates.

d. Both types of estimates should be controlled and carefully updated so as to result in a complete cost estimating history for a program.

e. Cost estimates must include Life Cycle Costs in sufficient detail and accuracy to permit Life Cycle Cost figures to drive program decisions.

f. At the time a development is identified as a system the Army will declare its intent to operate within the constraints of a given cost estimate. This estimate will be the one against which performance changes and cost growth will be measured.

g. Funds will be programmed to support that estimate which management decides is most likely. This may result in programming for an amount which is greater than that specified in a contract.

3. Procedures

a. The organizational responsibilities of the various agencies involved in the preparation and processing of baseline and independent cost estimates are shown in the inclosure. This also shows the normal flow for these estimates from the time they are generated until they are used in the decision making process. The interaction between the baseline and independent estimates should be characterized by a system of checks and balances. By presenting both views to a decision maker, he should be better able to assess the relative military worth

of a system and thus make sounder and more stable decisions on system development.

b. As shown in the inclosure, baseline cost estimates will procede through channels following the normal line of authority as they have in the past, from the Program Manager's Office to DSARC.

c. The independent cost estimate will be prepared in anticipation of review by the Army Systems Acquisition Review Council (ASARC). The ASARC should be anticipated by as much as one year for those systems on which the Army has poor historical data, and research should be initiated. For those systems on which the Army has an adequate data base, the analysis for an independent estimate should begin in sufficient time to permit the development of an independent estimate that can be substantiated and whose bounds of uncertainty are well understood.

d. The Director of Cost Analysis at Department of Army will appoint a chairman to take responsibility for the Independent Parametric Cost Estimate (IPCE) and for its final documentation and presentation to the ASARC and to the OSD Cost Analysis Improvement Group (CAIG).

e. Analysts from the Army Materiel Command, the involved commodity commands, and the PMO will be assigned to the IPCE Team which will meet at the principal commodity command. Analysts will gather data, assist in the derivation of cost estimating relationships (CERs), and assist in writing the final report. Dissenting views will be noted.

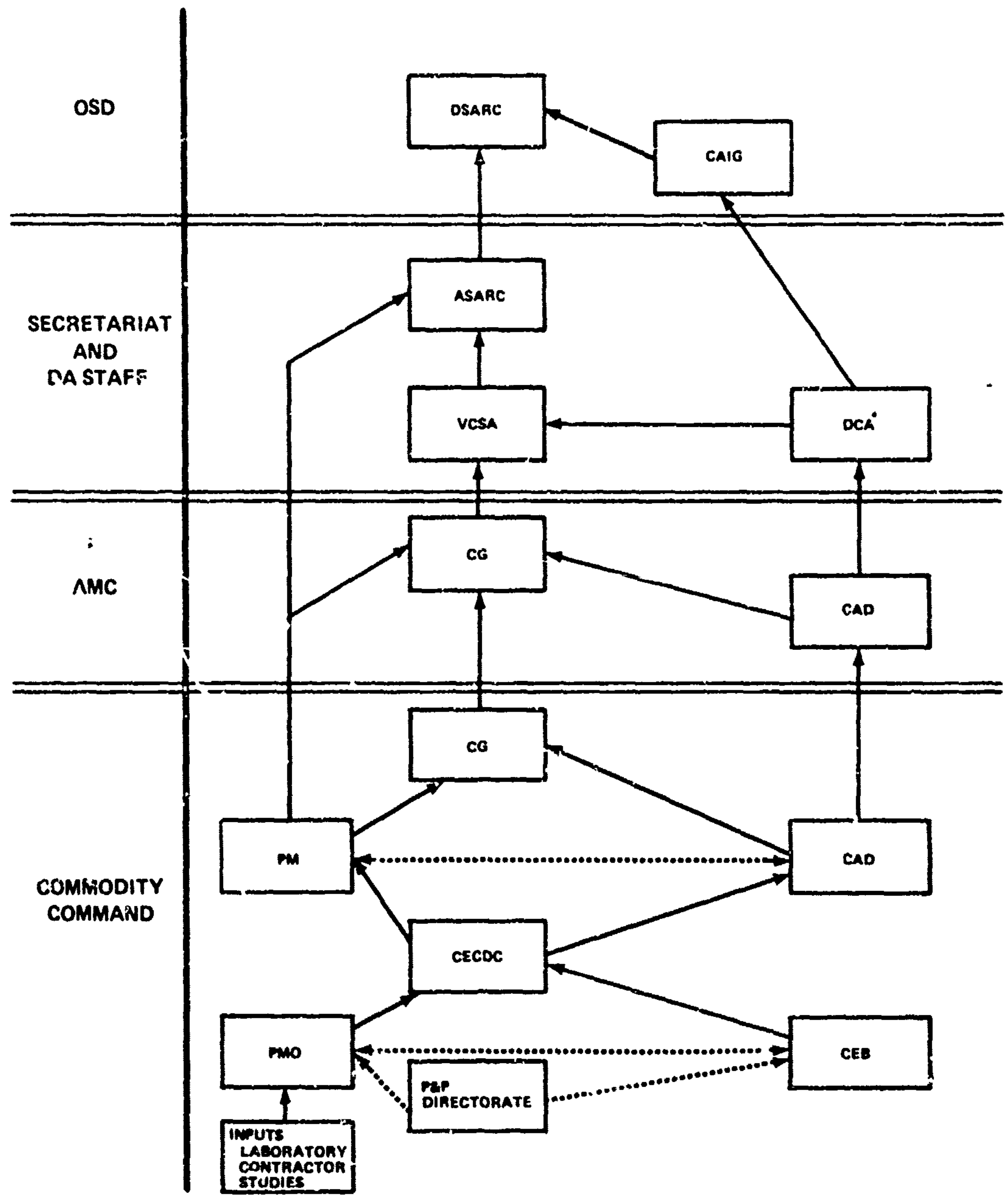
f. The IPCE Team will be organized to obtain the best possible results paying particular attention to individual capabilities. Assistance will be obtained from outside organizations as necessary and appropriate; e.g., hardware manufacturers having experience related to the system in question, analytical firms having related experience, the Office of the Director of Cost Analysis at OSD, and the other military services who have useful experience. Adequate funds for travel will be made available by an individual's parent organization.

g. The final results of the cost analysis will be the responsibility of the Director of Cost Analysis at Department of Army level, and those results will be formally documented so that they may be traced as the program progresses through the acquisition cycle. The report must state the limitations of the analysis, the level of confidence in the final estimate, the data base upon which the estimates are founded, sources of information, analytical models and techniques employed

(by reference, if appropriate), and other relevant material consistent with good analytical practice.

h. The IPCE will be made available to those decision makers who have access to the baseline estimate. Differences in the baseline and the independent estimates will be understood but not necessarily reconciled. It should be understood that estimates are by definition uncertain, and differences will occur among analysts for such reasons as using different cost analysis techniques or selecting different analogs.

1 Incl



→ ACTION
⇢ INFORMATION

PMO - PROJECT MANAGEMENT OFFICE
CECDC - COST ESTIMATE CONTROL DATA CENTER (PART OF CAD)
CEB - COST ESTIMATING BRANCH (PART OF CAD)
CAD - COST ANALYSIS DIVISION
DCA - DIRECTOR, COST ANALYSIS

WEAPONS SYSTEMS COST ESTIMATE FLOW CHART

CHAPTER V
TESTING TEAM REPORT

A. SUMMARY.

1. To permit Testing Team judgments relative to testing issues to be better communicated, the Team evaluated the current overall Army materiel acquisition process capability to meet Army needs. It was found that the current process is generally viable. Since the process is relatively new, it was not surprising to find uneven and imprecise perceptions of important details among people associated with the process, incomplete development of implementing regulations, and lack of appreciation of possible problem areas. Under strong management by a single Department of the Army (DA) staff agency, the process should be allowed to mature, closely monitored, and "fine tuned" before substantive changes are initiated.

2. The responsiveness of testing to the Army Systems Acquisition Review Council (ASARC) decision process and the adequacy of testing data for ASARC decisions were discussed with DA personnel. There is little evidence to validate responsiveness because newness of the process, and limited test result presentations, preclude analysis. A review of the minutes of the ASARC meetings reveals there have been no ASARCs and three in process reviews (IPR) at which the Operational Test and Evaluation Agency (OTEA) has had the responsibility and opportunity to present independent evaluations of operational test (OT) results. Conforming to current procedures, there were no presentations of independent evaluations of development test (DT) results, these being presented by Project Managers. An independent evaluation of DT results should be made to the IPR/ASARC. The ASARC and IPR process should be watched closely to insure that the decision process is working. Milestones, i.e., work completed, rather than deadlines, i.e., time completed, should be respected to insure that adequate testing precedes key decision points and the independent evaluations of OT and DT results are presented. Older projects should be recycled into the new process and newly stated principles applied to ongoing development programs.

3. Developers, users, and testers expressed considerable difficulties in sorting out the proper division of testing responsibilities between OT and DT. There is an actual difference both in concept and execution between DT and OT, but there is undesirable duplication,

primarily between OT and the service-use phase of DT. Since the service-use phase appears to be primarily OT oriented, most of these activities should be performed as OT, deleting the service-use phase from DT. This permits transferring some testing capability from the Army Materiel Command (AMC) to the Training and Doctrine Command (TRADOC). Both the materiel developer and combat developer require their respective organic test and evaluation capabilities, with OTEA continuing to design and evaluate user tests for high profile systems.

4. The current concepts and procedures concerning independence of testing are vague and uneven. Further, adhering to current Army philosophy probably is injecting unnecessary costs into Army testing. The current philosophy embodies two primary principles, independence (from the developer and user) of OT and, to attain this, separate conduct of testing and independence of evaluation presented directly by the evaluators to the decision makers. The independence from user and developer philosophy is pertinent and necessary; however, the emphasis should be changed from separate testing to independence of design and evaluation to permit more efficient use of testing resources applied to integrated or combined tests.

5. The force development testing and experimentation (FDT&E) capability of the Combat Developments Experimentation Command (CDEC) and the Modern Army Selected Systems Test, Evaluation and Review (MASSTER) is receiving increased emphasis in the Army and should, in time, provide the Army with an operational effectiveness data base for use in the development of Required Operational Capabilities (ROC) and against which future systems can be evaluated. FDT&E is a useful tool for combat development and the Army should devote substantially increased resources to upgrade the FDT&E capability so that a sophisticated data base for future ROC generation can be obtained on an accelerated basis.

6. The identification of required test activities and their optimum locations in the Army structure were of significance to many high level Army personnel. It was found that current Army facilities for testing were adequate in most cases; although, TRADOC requires additional user testing capability. The difference between OT and DT dictate different types of testing facilities. OT currently appears fragmented because of the structural dispersion of CDEC, MASSTER, and the Test Boards. There is a significant overlap into OT by the service-use phase of DT. TRADOC and OTEA manage all OT except the service-use phase of DT. To eliminate overlap, and to enhance

TRADOC testing capabilities, TRADOC should be strengthened to include CDEC, MASSTER, the Test Boards, and an analytic support capability. The Army Materiel Systems Analysis Agency (AMSAA) should be enlarged to include responsibility for the final DT evaluation. The Test and Evaluation Command (TECOM), less the Test Boards, would act primarily as a testing service organization. OTEA should be directly subordinate to Chief of Staff Army (CSA) and should, in addition to its present activities, plan to become more directly involved in OT of non-designated, non-major systems as deemed appropriate. TRADOC would continue to have the OT and FDT&E missions.

7. OT and DT are sufficiently different to justify separate facilities and organizations. At the same time, the need of AMC for DT capabilities, and of TRADOC for OT capabilities (including FDT&E), justifies having these capabilities organic to these commands. For these reasons, the Army should not establish a major testing command to accomplish developer and user testing separate from the materiel developer or the combat developer.

8. Although some progress has been made over the past decade, the identification of requirements is an area that still needs substantial improvement. In certain specific cases, the Army test process has been adversely influenced by instability of user requirements. A lack of clearly defined technical and operational performance characteristics has contributed to non-uniform interpretation of design (test) parameters. The developer, tester, and user should establish/standardize terminology to describe performance characteristics in the formulation and statement of requirements. The Army should place added emphasis on the process to insure responsiveness to changing needs by periodic reviews of requirement statements.

9. Prior studies have criticized the lack of user participation at various stages of the acquisition process. This raised the issue of user participation in the DT/OT process and whether modifications were indicated. It was found that the user is normally Forces Command (FORSCOM) or one of the non-CONUS forces, but that TRADOC functioned as the user or user's representative for 95% of the systems under development. TRADOC is afforded ample opportunity to participate in planning and evaluation of all testing, but has the option of remaining relatively passive. A more active participation of TRADOC in the user's representative role is mandatory.

10. The Army's attention to the closure/consolidation of test facilities has resulted in a significant reduction of activities specifically devoted to testing. Each of the test facilities considered by the Testing Team has a unique mission and unique features which do not duplicate existing facilities. To the extent duplication does exist, it is required for effective workload management. The major exception to this statement is Dugway Proving Ground. Dugway's primary mission was abolished in 1969 by a National Policy Statement which renounced use of lethal biological agents. The Army should consider placing Dugway in standby status, and transferring its current workload to other proving grounds.

11. There is a substantial amount of contract work performed in support of both AMC and user community testing. The majority of this effort is in the test support function, and could be expanded to provide increased flexibility and responsiveness to changes in the test workload. Increased use of contractor personnel should be viewed as a long term goal to be accomplished gradually as circumstances permit.

12. On the basis of limited data, the number of personnel assigned to the test function appears adequate and reasonable. The general policy of utilizing borrowed troops, on an ad hoc basis, to support testing is an efficient means of controlling test manpower. Past reductions in test personnel have been substantial. Further reductions would require: (1) increased use of contractors, (2) base closures, or (3) reducing the amount of testing currently being performed. Opportunities, such as having regular troop units become available for CDEC use to replace those troops now dedicated and organic to CDEC, should be exploited to reduce testing manpower further.

13. During discussions with CDEC and MASSTER personnel, it was observed that a small amount of innovative discretionary testing has been accomplished to evaluate the potential of new items/concepts for possible future Army use. This informal process is used successfully by some industries to encourage innovation and produce some low cost, high payoff performance. The Army should institute a small discretionary test program to allow test commanders to perform limited testing for the purpose of evaluating new concepts in force development or materiel systems.

14. The current test report process is highly structured, and relies principally on an institutional evaluation on the part of concerned test agencies. The opinions of knowledgeable personnel are consequently subordinated in the reporting process with an inherent loss of valuable intelligence. The current test report process should be modified to provide for a compendium of evaluations to accompany the report providing a vehicle for the transmittal of opinions of key personnel involved in the test process.

15. Excessive rotation of military personnel is having an adverse impact on the materiel acquisition test process. Additional emphasis is required to insure the availability of qualified personnel. Action should be taken to expand career development opportunities for both civilian and military personnel and increase the use and duration of current stabilization programs. The personnel process must be structured to attract and retain capable civilian and military personnel from all Army elements into key management positions.

16. The Squad Automatic Weapon System (SAWS) test program was studied to determine if an objective and unbiased plan of test had been developed which would not penalize any of the competing candidate systems. No evidence of bias was found.

17. The test organization and procedures recently implemented by the Army, as modified by the Army Materiel Acquisition Review Committee (AMARC), should reduce the chances that many of the problems associated with the M-16 rifle development program would be repeated. These procedures include the current high level structured decision process; the recommended increased emphasis on force development testing; and better defined, highly visible, increased amounts of operational testing. The key factor in precluding problems associated with the M-16 rifle is better definition and validation of operational requirements.

MAJOR CONSIDERATIONS

B. MATERIEL ACQUISITION PROCESS.

1. Issue.

Is the current organization of and procedure for the Army materiel acquisition process capable of meeting the Army's needs?

2. Discussion.

a. This issue encompasses more than testing. It was selected because our recommendations with respect to testing issues would be better communicated and understood if presented in the context of our evaluation of the acquisition process.

b. In general, as outlined on paper, the process is basically sound and capable of meeting the Army's needs. However, since the process is new, there is a risk of deterioration for want of management, and/or because of premature major modifications. Responsibility for management of the process is unclear. ACSFOR is tasked to oversee life cycle management of systems, but CRD, DCSLOG, and others have major and sometimes overriding influence on the process. There appears to be no single universally recognized and accepted manager of the process concept in toto who overwatches all of the systems in development to insure coordinated compliance with process requirements and/or to modify the process concept as appropriate to enhance its effectiveness. (Although its mission is not yet firm, DCSRDA will have a major part of this function.)

c. Perceptions of the main principles and structure of the new process are widespread and generally uniform both in the field and at top management levels; however, important details of the process, such as testing missions and functions, are not clearly understood. There are indications, particularly from PMs, testers, and others at the working level, of general recognition and acceptance of the form and substance of the new process. There are also indications of an apparent difference of perception of process details (e.g., the purposes of and methodologies used in DT and OT) fostered by ambiguous and incomplete implementing documentation, which leads to a lack of common objectives in attaining development program goals. Other implementing documents, particularly regarding DT/OT, have not been published and are urgently required in the field.

d. It is unclear whether the "actors in the process" (developers, users, testers, trainers, etc.) are sufficiently "street wise" to anticipate and avoid potential problems. There is a need for Army management at all levels to be aware of potential problems, such as the adverse effects on testing of changing requirements, the tendency to overstate goals and objectives for the developmental

systems, reluctance to abandon disproved systems, and eagerness to accept unproven or compromised items at decision points.

3. Recommendations.

a. The current materiel acquisition process should be allowed to mature.

b. An existing single DA staff element should be designated to manage the concept of materiel acquisition, recommending necessary changes to "fine tune" the process, monitoring the system development programs to determine compliance with DoD and DA guidance, promoting a common understanding of the process among the DA community, and in particular directing publication of implementing guidance.

C. TESTING-DECISION PROCESS RESPONSIVENESS.

1. Issue.

Is the test process responsive to the needs of the IPR/ASARC decision process and are IPR/ASARC decisions based on adequate testing data?

2. Discussion.

a. This issue surfaced during interviews with Project Management, TECOM, and OTEA personnel when the process for presenting test data to the IPR/ASARC was discussed.

b. There is limited evidence to resolve the issue because of the newness of the process. OTEA has presented independent evaluations of OT results at three IPRs as required. In all cases, the OT independent evaluation was favorable to the system, and the decision was made to proceed with the development process. There has been no opportunity for OTEA to present OT results to an ASARC. The results of DT are presented to the IPR/ASARC by the PM. This presentation of DT results does not constitute an independent DT evaluation.

c. All ASARC minutes and a large sample of IPR minutes were analyzed. Coordination of the minutes with all ASARC/IPR members, prior to publication, is required; therefore, the minutes

represent an accurate statement of the proceedings. The minutes of the IPR/ASARC meetings give cause for concern. None of the minutes reflected significant differences of opinion, none showed disagreement, and the result was an innocuous record of lively debate. A fuller disclosure of the proceedings (but not a verbatim record) and the inclusion of minority positions would provide a more useful record.

3. Recommendations.

a. The IPR/ASARC meetings should be watched closely to insure that the decision process is functioning as planned.

b. Milestones, i.e., work completed, rather than deadlines, i.e., time completed, should be respected to insure that adequate testing precedes the IPR/ASARC meetings.

c. DT independent evaluations should be presented directly to the IPR/ASARC.

d. Older projects should be recycled into the new process and the newly stated principles should be applied to the ongoing work.

e. The IPR/ASARC minutes should include substantive differences of opinion (but not a verbatim report) and should include minority opinions on controversial issues.

D. DT-OT DIFFERENTIATION.

1. Issue.

Are development and operational test concepts significantly different? If not, how much do they overlap?

2. Discussion.

a. This issue evolved when it became clear during discussions with Project Management, TECOM, and OTEA personnel that there is limited understanding of the differences and overlaps existing between development tests and operational tests.

b. There are fundamental differences between operational and development testing, and Army concepts of OT and DT apparently are

intended to be significantly different. The documented expression of DoD T&E concepts contains a fairly clear differentiation between DT and OT, however, perceptions of the differences in the Army's materiel acquisition testing community (including the testers) are fuzzy. Expression in Army Regulations and other implementing documents of the DT-OT differentiations is not consistent, does not reflect completely DoD views of DT and OT, and sustains in the new era of OT the old service-use phase method of field testing equipment.

(1) A test is "a process by which data are accumulated to serve as a basis for assessing the degree that a system meets, exceeds, or fails to meet the technical or operational properties ascribed to the system."[1]

(2) DT focuses on testing "those characteristics of equipment which pertain primarily to the engineering principles involved in producing equipment possessing desired military characteristics ..."[2]

(3) OT focuses on testing "the specific military qualities of performance and capability required of an item of equipment to enable it to meet an agreed operational need."[3]

(4) Currently, one phase of development testing of systems is being conducted under simulated or actual operational conditions with user troops to determine whether the specified military requirements or characteristics are satisfied. These activities are called the "service-use phase of DT."

c. Document analysis and discussions with Project Managers, the testers, and others indicate that the old "testing culture" associated with field testing in Service Tests and Expanded Service Tests performed by TECOM under former materiel acquisition processes have been pulled forward into the new process. Since many activities in this phase appear to be primarily OT, this had led to an undesirable overlapping of the new OT functions, primarily with the DT service-use

---

1. AR 310-25, Army Dictionary, emphasis added.
2. Definition of "technical characteristics," AR 310-25, Army Dictionary.
3. Definition of "operational characteristics," AR 310-25, Army Dictionary

phase. (Human engineering testing should continue, and specific man-machine interface and quasi-laboratory elements of the current service-use phase testing should remain in the DT category. This acknowledges the legitimate requirement of the developer to utilize troops in the conduct of development tests.)

d. The most pronounced grey area is found between OT II and the service-use phase of DT II. The DT service-use phase is considered by many to overlap significantly with the newly introduced concept of OT, which is accomplished with representative user troops in as realistic an environment as possible to estimate military utility, operational effectiveness, and suitability, from the users' viewpoint, the system's desirability, need for modification, and training for its employment, and the system for its maintenance support. It should be noted that the perceived overlap between OT and DT service phase probably is not nearly total. Only a detailed, in depth analysis of the respective DT and OT test processes and objectives could identify the issues sufficiently to permit resolution. Action is required to reduce costs, ease the confusion which now exists about DT-OT roles, and to remove to the extent possible the appearance of duplication. There is a need for experimentally validating knowledge for evaluating basic design trade-offs (e.g., armor versus mobility) as a function of mission and doctrine as well as materiel.

3. Recommendations.

a. Criteria similar to the following should be established to assist in differentiating DT from OT: If the test

(1) Environment is operational (realistic) - OT

(2) Troops/units are representative (typical) - OT

(3) Methodology uses military operational judgments - OT

(4) Objectives include: training, personnel requirements, doctrine, operating techniques, tactics - OT; threat, employment concepts, deployment - OT; RAM (Operational Effects) - OT; RAM (Technical) - DT; specifications, engineering, design, production - DT; technical performance, safety, human factors (man-machine interface) - DT.

b. DA should affirm the concepts of DT and OT to emphasize the technical orientation of DT and the operational orientation of OT. These concepts should be expanded for implementation and published as soon as possible.

c. The concepts associated with DT service-use phase should be discarded.

d. DA should identify the need for basic design trade-off data and task TRADOC with the mission of accomplishment.

E. INDEPENDENT T&E-THE ARMY CONCEPT.

1. Issue.

What is the Army's concept of independent test a[illegible] ation? Does it fit the need?

2. Discussion.

a. We encountered numerous and often vague interpretations of the terms "independence of testing," "independent evaluation," and "separate tests." The Army's concept of independence of testing is currently based on the principles of independence (from the developer and the user) of test design, test conduct, test reporting, and evaluations presented unchanged to the decision making authority.

b. DA requires an organization (OTEA) which independently designs, evaluates, and presents evaluations to the decision makers of user tests of high profile systems. OTEA now provides this function for major and designated non-major system OT. Similarly, there must be an organizational element to provide this function for DT. To provide this evaluation, these organizations must also have a test design capability and the ability to influence the conduct of tests. The results of the DT/OT independent evaluations should be presented at each appropriate decision point.

c. There is a firm requirement to maintain credibility with Congress and the Army user. Past problems of the Army relating to the lack of OT emphasis and possible developer bias toward procuring unready systems continue to be potential risks for the Army.

d. Independence of evaluation is the essential cornerstone in achieving test credibility throughout the acquisition process. Independent evaluation does not imply the necessity for the conduct of separate and independent tests. In most cases, required development/operational tests should be performed on an integrated basis to eliminate duplication. Both AMC and TRADOC require organic test capabilities to perform independent test design and evaluation of DT and user tests respectively. These capabilities, for both DT and user testing, should act as service organizations mutually supporting the generation of both development and operational test data. Strong control at the DA level will insure an effective balance and guarantee the adequacy of operational testing.

3. Recommendations.

a. The Army should emphasize independence of test design and evaluation rather than separate testing.

b. AMC should establish the capability to perform DT independent test design and evaluation.

c. OTEA should be made immediately subordinate to the Office of CSA to continue OT emphasis and independence for high visibility systems.

F. FDT&E EMPHASIS.

1. Issue.

Is the Army placing sufficient emphasis on increasing its Force Development Test and Experimentation capability?

2. Discussion.

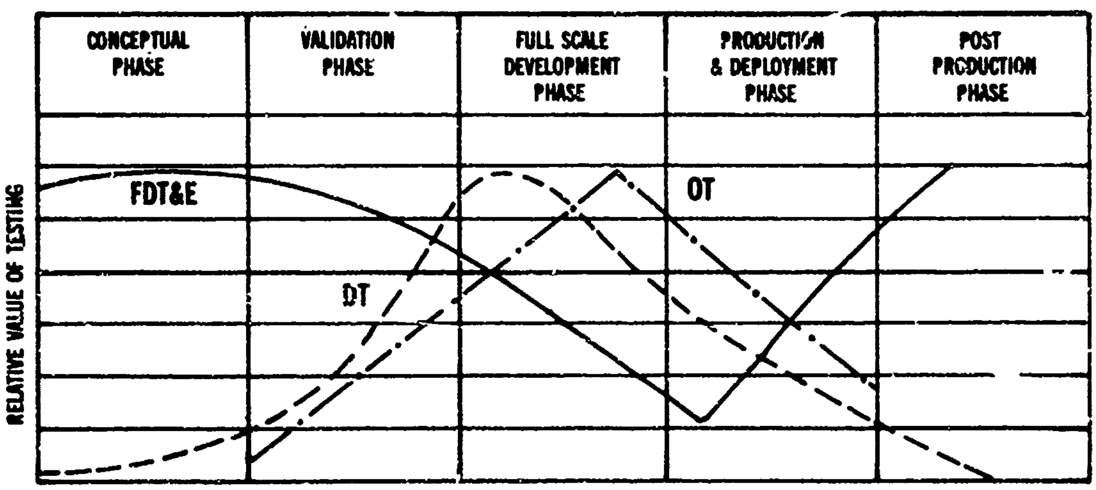
a. We wanted to investigate the potential contribution of FDT&E in providing a better data base for ROC generation and in assessing the effects of alternative doctrine, tactics, and organization.

b. The Combat Developments Experimentation Command (CDEC) was formed in 1956 with the specific mission of conducting field experimentation. The program received emphasis from General C. Abrams in 1966 and, since then, CDEC has become

increasingly sophisticated in its approach to experimentation. FDT&E was further enhanced by realigning and expanding MASSTER's mission to emphasize force development testing. FDT&E is receiving increased emphasis in the Army.

c. The contribution of FDT&E to the acquisition process is depicted in Figure V-1. DT/OT relative value curves have the same characteristic shape, providing maximum useful contribution immediately prior to type classification. FDT&E makes its maximum contribution to development of a system in the conceptual and validation phases. In the deployment and post production phases, the combat development elements use FDT&E on the system as a basis for evaluating the potential of second generation hardware. TRADOC combat development elements require additional capability to perform FDT&E.

FIGURE V-1. FDT&E CONTRIBUTION



d. More effective discipline and coordination of the FDT&E process became evident with the formation of the Test Scheduling and Review Committee (TSARC) in 1973 with the task, among others, of coordinating FDT&E effort. The coordinated program is now included in the published DA Five Year Test Program. FDT&E is now primarily accomplished by CDEC and MASSTER with limited

additional work performed by other agencies. The TRADOC combat development elements located at the Combat Arms Centers possess little inherent FDT&E capability. The amount of work performed by the Centers should be expanded.

e. The Army does not have an adequate data base against which to measure operational effectiveness. Such a data base for current weapon systems should be developed to provide a basis for evaluating new concepts and marginal increases in effectiveness promised by new systems. There is no evidence that the requirement for such a data base has been developed nor is required information being developed on a systematic basis. Further, more work should be directed toward the early assessment of innovative ideas dealing with tactics and doctrine.

f. To some extent, adequate FDT&E was precluded in the past by the non-availability of suitable instrumentation. Instrumentation coming on-line at MASSTER in 1974-75 should help alleviate this deficiency. FDT&E could be improved substantially by the addition of suitable instrumentation. Recent steps taken by the Army in developing a structured FDT&E program, and increasing instrumentation support, should provide a firm baseline for improving FDT&E.

3. Recommendations.

a. FDT&E should be redirected to emphasize the generation of an operational effectiveness data base for development of the ROC and against which future systems can be evaluated.

b. Additional resources should be devoted to improving FDT&E testing.

STRUCTURAL/ORGANIZATIONAL ISSUES

G. TEST ACTIVITIES.

1. Issue.

What should the test functions be and where should they be located in the Army structure?

2. Discussion.

a. This issue was raised in the Under Secretary of the Army's 6 December 1973 memorandum, which established the AMARC, and during our discussions with the AVCSA and others.

b. In order to improve the Army's FDT&E posture, and eliminate the significant overlap between OT and the service-use phase of DT which appears more appropriate to OT, it will be necessary to reorient the test structure. The physical and facility requirements for OT are significantly different from those for DT. Presently available testing facilities for DT and OT appear to be substantially adequate for needed tests when considered as an entirety. However, FDT&E is fragmented due to the organizational dispersion of CDEC, MASSTER, and the centers for combat development. TRADOC should be strengthened by the addition of MASSTER, the AMC Test Boards, and an enhanced analytical capability, with the mission of performing FDT&E and OT. TRADOC would perform tests as a service for other TRADOC customers, OTEA, and the developer. It would function on a parallel basis to the development test command for AMC.

c. TRADOC is responsible for the management of OT of non-designated, non-major systems under the general policy guidance of the DA staff, while OTEA manages OT of major and designated non-major systems. TRADOC would retain primary responsibility for most non-designated, non-major OT. Only when problems surfaced on a specific item would OTEA enter active participation. TRADOC would also retain the FDT&E mission. At the present time, we find FDT&E inadequate due to insufficient TRADOC command emphasis. TRADOC combat development elements would perform all necessary combat development functions, in addition to conducting OT of non-designated, non-major systems. AMC, as the materiel developer, would continue to maintain development testing capabilities in the development test command and evaluation capabilities in AMSAA. DT responsiveness directly to the materiel developing community is vital to successful results. TRADOC could request testing to be conducted by the development tester and vice versa as appropriate. Man-machine interface testing would still be carried on by the developer. Evaluations would be performed by OTEA, TRADOC, and AMSAA.

3. Recommendations.

a. Some Army test activities and responsibilities should be restructured.

b. TRADOC should include CDEC, now under TRADOC; MASSTER, now under FORSCOM; the Test Boards, now under TECOM-AMC; and an additional analytic support capability derived from the Safeguard Systems Evaluation Agency (SAFSEA) and other sources.

c. The development test command should include all the present TECOM except for the Test Boards and the final evaluation responsibility. It would be primarily a testing service organization.

d. The AMSAA mission should be enlarged to include direction of all DT I, DT II. and DT III evaluations including that currently done by TECOM.

e. OTEA should report directly to the Chief of Staff of the Army, and develop plans to accept taskings, in addition to its present activities, to oversee the more significant non-designated, non-major systems and to participate in OT and evaluation as deemed appropriate on an individual basis.

H. MAJOR TESTING COMMAND.

1. Issue.

Should the Army have a major testing command separate from and parallel to AMC?

2. Discussion.

a. In conversations with DA and DoD personnel, many suggestions were offered which indicated that the concept of a separate major testing command should be studied.

b. Development testing is a basic responsibility of the materiel developer. The inter-relationship between DT and the development process is such that all efforts should be made to maintain DT responsiveness to the materiel developing community. Organizational changes which separate DT capabilities from the developer should be avoided. Similarly, the inter-relationship of user testing, both OT and FDT&E, and the development of materiel

systems, tactics, doctrine, and organizational considerations are such that these functions should be closely aligned with the current TRADOC organization. User testing is a necessary tool of the combat and force developers. Development and user testing are sufficiently different to require different and separate test facilities. The materiel developer has a vital interest in the man-machine interface. Testing required by the developer which can best be accomplished using operational test facilities can be obtained on a customer basis. In similar cases, where development test facilities are required, the user testers can request work as customers.

c. This parallel structure will provide the major Army participants with those test resources necessary to accomplish their assigned missions. Further, this structure will enable the DA staff to strike a balance between the two types of testing being performed to satisfy the critics of the past materiel acquisition process. This structure should provide TRADOC with the test facilities necessary to accomplish their currently assigned combat development mission. It will not significantly impair the ability of the developer to accomplish development testing. Only when facility cost considerations are a driver, such as with National Ranges, should development and user test facilities be combined. This discussion considers separation of the test function only and does not address the evaluation function of OTEA, TRADOC, or the materiel developer.

3. Recommendation.

The Army should not establish a major testing command to accomplish development and user testing separate from the materiel developer or the force developer.

FUNCTIONAL ISSUES

I. INSTABILITY OF REQUIREMENTS-EFFECTS ON TESTING.

1. Issue.

Is the Army's DT/OT test process adversely influenced by instability of user requirements?

2. Discussion.

a. Based on the case studies and from information received during discussions with the Project Managers, we felt that the Army needs to take action to establish and maintain firm requirements throughout the development cycle.

b. Since 1962, the definition of requirements has become more precise in terms of both technical and operational performance characteristics. This improved definition has tended to focus management attention on excesses in the generation of requirements which had heretofore gone undetected. Given the duration of the development cycle, changes in requirements dictated by threat, tactical, and technological considerations must be anticipated. These changes have not been processed in a timely manner. AMC and TRADOC believe that user requirements are basically stable, and that instability, per se, does not adversely influence either testing or any other phase of the development process. This is generally supported by evidence made available to us. However, there is also evidence, in a number of specific programs, where indecisiveness in generation of requirements and inordinate numbers of requirement changes have acted to the detriment of the development (test) process. This is particularly characteristic of high technology, complex programs.

c. The attempt at increased precision has introduced a second order problem associated with interpretation of technical and operational performance parameters. Lack of clearly defined technical and operational performance parameters has contributed to non-uniform interpretation of design and test parameters (e.g., system effectiveness) by the developer, tester and user. This is an obstacle in evaluating the success with which the developer satisfies the user and the process satisfies DoD and Congress. There is a decided reluctance on the part of the Army to abandon or reschedule items and concepts early in the development cycle when technological problems become evident. The IPR/ASARC have responsibilities to identify candidates for project termination and/or recycle them through validation when technology and/or cost effectiveness considerations indicate such action advisable. The IPR/ASARC are effective forums for resolving, on a near term basis, the problem of interpretation of stated requirements.

IPR/ASARC decisions approving the basic requirements, and changes thereto, as well as providing required clarification should minimize intraservice problems which have characterized past controversial programs.

3. Recommendations.

a. The developer, tester, and user should establish standardized terminology to describe performance characteristics in the formulation and statement of requirements.

b. The Army should place added emphasis on the process to insure responsiveness to changing needs by periodic reviews of requirement statements.

J. USER INFLUENCE ON DT/OT.

1. Issue.

To what extent does the user influence the DT/OT test process? How should this be modified?

2. Discussion.

a. This issue was selected because prior studies have criticized the lack of user participation at various stages of the acquisition process.

b. The "user" is the active Army component who will utilize materiel in the field. The user is not generally available for participation in the acquisition process, including testing. For 95% of the systems under development, TRADOC is designated by ACSFOR as the user or user's representative and is "charged with the responsibility to insure that a system under development is responsive to the user's operational needs." TRADOC, in turn, names one of its schools or centers as proponent for each system. Approximately 1100 systems fall into this category. Of these, approximately 300 are listed in the Catalogue of Approved Requirements Documents (CARDS) as under development.

c. In general, TRADOC participation in DT/OT is less than desirable. Active participation of TRADOC as the user or user's

representative is required. Army regulations afford TRADOC the opportunity to provide an input to all DT/OT test plans and to comment on test reports and evaluations. It may be appropriate to revise regulations to direct the extent of this increased participation. TRADOC has numerous responsibilities during the acquisition process. These responsibilities include: verifying that a system is responsive to operational needs; participating in preparing and updating development plans; serving as a member/observer of the IPR/ASARC/TASK FORCE; conducting OT; providing an input to DT/OT I, II, and III, including preparing OT plans and evaluations. TRADOC receives all test results and evaluations.

d. Since TRADOC generates most ROCs, the ROCs represent TRADOC's perception of the user's needs. In most cases, the user has not requested a system to fill a demonstrated need. This should not be taken to fault either TRADOC or the user. Frequently, TRADOC may be able to perceive future needs of the user better than the user himself, who operates more in the present.

e. Although TRADOC has inputs to the test program at all phases of the program, has membership on the IPR, and makes presentations to the ASARC, it appears that his desires have not always been granted. While this may be partially due to decision by higher authority, it may also have been due to lack of active and aggressive participation on the part of the user, whose choices ranged from passive to highly active.

3. Recommendation.

TRADOC should more actively pursue its role as the user's representative.

MANAGEMENT ISSUES

K. CLOSING/CONSOLIDATING FACILITIES.

1. Issue.

Can we close/consolidate some of our test facilities? If so, which?

2. Discussion.

a. This issue was selected because it was identified in the Under Secretary of the Army's 6 December 1973 memorandum, which established the AMARC.

b. Since 1962, AMC has made continued progress over the last ten years in closing and consolidating test facilities. One result of this effort is that TECOM now possesses 14 installations and activities where 44 had previously existed. Each of these installations and activities has a distinct mission orientation and unique features. To the limited extent that duplication does exist, it is required to support current workload. We believe that CDEC and MASSTER do not represent redundant test facilities in that assigned programs are structured to take advantage of facilities, real estate, and availability of personnel. We encourage the expansion of these capabilities as part of the real requirement for additional FDT&E.

c. The one notable exception to this picture is the continued existence of Dugway Proving Ground in the face of President Nixon's National Policy Statement of 25 November 1969 which renounced the use of lethal biological and toxic agents and weapons. The primary mission of Dugway Proving Ground, prior to November 1969, was testing biological and toxic agents. Since 1969, Dugway's mission has been limited to testing chemical weapons and biological defensive systems. This latter mission could be conducted at other Army installations and activities. This would require the relocation of certain instrumentation and facilities and the transfer of key personnel. Dugway Proving Ground is the least cost effective proving ground analyzed on the basis of its currently assigned workload and intended mission capability.

3. Recommendation.

The Army should consider placing Dugway Proving Ground in standby status and transferring the current workload to other government proving grounds.

L. SUPPORT CONTRACTOR TESTING.

1. Issue.

How much of proving ground, range, and similar test activity effort can be performed by support contract?

2. Discussion.

a. This issue was selected because it was identified in the Under Secretary of the Army's 6 December 1973 memorandum, which established the AMARC.

b. Although there is a substantial amount of contractor work now performed in support of testing, we feel that all government test activities would possess increased flexibility and additional responsiveness to changes in the level of workload if more extensive use were made of support contractor personnel. CDEC utilizes contract support in planning and evaluating field experimentation. TECOM makes wide use of contractor support in such non-mission areas as instrumentation, operation, and maintenance. The TECOM test boards do not utilize significant amounts of contractor support. Contractor personnel can be utilized in the operation and maintenance of instrumentation and in the collection and analysis of data without compromising the objectivity of assigned test programs. Additional support contractor personnel would be effective at all test activities and would afford some cost savings to the government in addition to providing additional management flexibility in the face of rapidly changing workloads.

c. The technical simplicity and repetitive nature of the work performed at Jefferson Proving Ground makes this installation an ideal candidate for a nearly complete support contractor operated facility. This is especially true if the small amount of research and development testing currently performed at Jefferson were reassigned either to Aberdeen or Yuma Proving Ground.

d. We recognize that expanded use of contractor personnel cannot be accomplished overnight. Conversion to contractor personnel should be viewed as a long term goal and accomplished gradually as changes occur in the complexion of assigned work.

3. Recommendation.

The Army should consider more widespread use of support contractors for both mission and non-mission areas.

M. PERSONNEL REDUCTIONS.

1. Issue.

Where can personnel reductions best be made?

2. Discussion.

a. This issue was selected because it was identified in the Under Secretary of the Army's 6 December 1973 memorandum, which established the AMARC.

b. The time available for the current study did not allow in-depth analysis of the current workload at each Army test installation or at each activity. From the available data, it appears that the current test workload justifies the present number of personnel assigned to the testing function. The Army test community has reduced its overhead structure in favor of direct mission efforts as a result of pressure for manpower reductions at the DA level. The ratio of personnel assigned in direct support of testing to those performing overhead functions appears reasonable. Extensive use of borrowed troops to perform operational testing on an ad hoc basis is an effective way of minimizing the total number of personnel directly associated with the test function. Additional savings may be attainable. For example, of the approximately 1500 dedicated test troops now organic to CDEC, some should be considered as candidates for reduction in the event that regular troop units can be made available.

c. Further reductions in the number of people associated with testing can be accomplished if an alternative means of accomplishing the work is identified. There are many areas where contractor personnel could be utilized to the advantage of the government. To the extent that support contractor personnel are utilized, a comparable savings in the military/civil service work force can be effected. Personnel savings will result if the Army acts on the AMARC's recommendation to place Dugway Proving Ground on a standby basis. Transfer of the current workload from Dugway to other installations and activities will permit personnel savings to the extent that Army personnel are required to perform base operations and overhead functions.

3. Recommendation.

Reductions in personnel should be implemented to take advantage of those situations where increased use of support contractor personnel and base closures are feasible.

N. DISCRETIONARY TESTING.

1. Issue.

Should the Army establish a funding scheme that would encourage a test organization to conduct a limited amount of discretionary testing?

2. Discussion.

a. We felt that a discretionary testing program, similiar to those used so successfully in some industries, would provide the Army with a capability that would encourage innovation and produce some low cost, high payoff performances.

b. Although there are no formal discretionary testing programs for systems in the development phase, there is a precedent for this type of program. AMC has an In-House Laboratory Independent Research Program (ILIR) which allows the Lab Director wide latitude to support work which he judges to be promising in direct support of the assigned mission. The funds are allocated to the Lab Director by the ASA (R&D) and the program is designed to strengthen in-house competence by providing for basic and applied research, testing, and component development on any problem areas assigned to the Lab. The FY 74 funding is approximately $8 million, is AMC wide, and applies only to the 6.1 Research category.

c. MASSTER has conducted a small amount of innovative discretionary testing and the results indicate that a small discretionary test program could provide additional flexibility and rapid response in evaluating new concepts in force development or materiel systems. Such programs could have a substantial effect on initial generation of requirements. Any discretionary test program should be small and in the order of 5% of the testing budget.

3. Recommendation.

The Army should institute a small discretionary testing program to allow the Commanders of the test organizations to perform limited testing of items that do not have a stated requirement.

O. TESTING AGENCY EVALUATIONS.

1. Issue.

Should the testing agencies append individual opinions as well as an institutional evaluation to their agencies' reports of test results?

2. Discussion.

a. We felt that individual opinions of knowledgeable test personnel would provide important insights for later review by higher authority.

b. The current test report process is highly stylized and relies principally on an institutional evaluation. The institutional evaluation is an integral part of DT/OT reports widely disseminated throughout the Army. This evaluation reflects the formal position of the test agency responsible for the preparation of the test report. Hence, the Army is faced with TECOM/OTEA/CDEC/MASSTER positions concerning the outcome of assigned tests. The opinions of knowledgeable personnel become subordinate to the official agency position and, therefore, represent a loss of valuable intelligence concerning the concept, execution, and findings of the test program.

c. We indorse the principle of a test report consisting of a data and digest portion which reports and analyzes test findings, plus the required appending of an evaluation and recommendations, including opinions, of all levels of personnel associated with the test program. This compendium of evaluations should include all program collaborators, i.e., AMC, OTEA, TRADOC, etc. These appendices should not be edited or deleted, but should be limited to comments based upon content. Further, this complete report should be circulated to all participants, affording them the opportunity to add to or modify their previous comments.

d. This procedure would provide a clear audit trail of the positions taken by knowledgeable personnel associated with the test program and insure that vital intelligence is available to key decision makers.

3. Recommendations.

a. The opinions, restricted to test content, of test project officers, test directors, and other personnel intimately knowledgeable of test results, should be appended to test reports disseminated throughout the Army.

b. Consideration of all knowledgeable opinions concerning test content should become part of the total evaluation process.

P. TESTING PERSONNEL STABILITY.

1. Issue.

How much stability should there be in military test personnel assignments?

2. Discussion.

a. Case studies and ad hoc Army study groups indicated a lack of significant experience in the project management organization. We confirmed this impression during interviews and sensed a carry-over of this issue into the testing community. We found that rotation of military personnel is having an adverse impact on the Army materiel acquisition process and continuity afforded by extensive use of civilian deputy positions does not assure consistent technical program guidance.

b. The Army is sensitive to the requirement for knowledgeable, key personnel during the acquisition cycle. This sensitivity was discernible in discussions with the principal test organizations. The Army is to be commended for current efforts to upgrade the professional staff, both military and civilian. One example of this effort is the AMC criteria for selection of project managers. The quality of personnel is an overriding factor in determining success or failure. Data reviewed indicates that substantial additional progress must be made in both upgrading the qualifications of key military/civilian personnel and in extending the length of assignments. Three year "stabilized" tours are inadequate in a materiel acquisition process with an average duration of eight years for major items.

c. It is imperative that the importance of the RDT&E process be reflected in the grade structure of key personnel assigned to manage large, high technology programs in all organizations. The current RDT&E grade structure is not considered adequate to attract the best qualified personnel. The personnel selection process must be structured to attract the best qualified civilian and military personnel from all Army elements into key management positions.

3. Reco .mendations. We concur in the Development Team's recommendations and, in addition, recommend that:

a. Consideration should be given to expanding career development opportunities in RDT&E for both civilian and military personnel.

b. Key military positions should be afforded priority assignments and stabilized over a period related to major phases of the development program.

c. Additional key positions should be designated for civilian management.

d. The RDT&E grade structure should reflect the magnitude and complexity of assigned programs.

ASSOCIATED CASES

Q. SAWS TESTING.

1. Issue.

How was the testing program for the Squad Automatic Weapon System (SAWS) planned? How will it be conducted?

2. Discussion.

a. This issue was raised at the 1 February 1974 Chairmen's meeting where it was feared by some that the in-house competitor for the SAWS might be favored by the Army testers and/or the in-house competitor might gain an unfair advantage over the two industry competitors by obtaining information on their errors and problems.

b. Review of current SAWS planning indicates that a fully coordinated, objective, and statistically adequate DT I/OT I test program has been developed. Exhaustive coordination of test concepts, crit ria, and methodology has been accomplished within the development, user, and operational communities. DT/OT I was planned by TECOM/OTEA with major inputs from AMSAA, TRADOC, and the developer. All parties agree that the approved Materiel Need (MN) will be used to evaluate all system performance parameters on a comparable basis

to determine which competing system demonstrates maximum potential for further development. Early definition of failure criteria, reliability criteria, and maintainability criteria have been accomplished. Sample sizes, although considered minimal, are adequate from a statistical viewpoint. Based upon lessons learned from the M-16 program, ammunition development and testing are highlighted in the current test plan documentation as part of the reliability subtest. Caution has been exercised in developing a universally agreed upon statistical design. Results of all firing tests will be combined into a single analysis of variance, using target hits as the independent variable. Thoroughness of planning should preclude future criticism of test adequacy.

c. The Coordinated Test Program as well as detailed test plans have been distributed to all program participants. Contractor personnel will witness tests of all competing systems. Tests will be performed by TECOM, OTEA, and TRADOC personnel at Frankford Arsenal, Rock Island Arsenal, Aberdeen Proving Ground, and the Infantry Test Board. There is no evidence to suggest any bias in the planned test program to favor any of the candidate systems.

3. Recommendations.

We have no recommendations to offer.

R. M-16 RIFLE TESTING.

1. Issue.

To what extent would the testing organization and procedures defined by the current Army materiel acquisition process eliminate problems encountered in M-16 rifle development?

2. Discussion.

a. The M-16 case study and SECDEF comments indicated that a deficient test program was a contributing factor to the difficulties experienced during M-16 development. We wanted to assess the adequacy of the current process to preclude these deficiencies from occurring again.

b. Analysis of the M-16 case study indicated that:

(1) The M-16 problems were not so much a failure of testing but rather a slowness of "the system" to correct deficiencies identified by testing.

(2) The test conduct and identification of problems were generally well done and with little bias.

(3) A large number of tests (more than 250) were conducted in an uncoordinated fashion by many different activities resulting in duplication of testing, lack of timely testing, and conflicting test results and recommendations.

(4) Documentation can be found to both support and refute many of the various study group findings and allegations.

(5) Decisions which were made did not always reflect consideration of available test results.

(6) Specific areas of neglect included appropriate testing and analysis of kinematic behavior, especially with regard to variations in propellant, and limited development work by the Army (which originally was buying an off-the-shelf item).

c. Numerous examples exist of the slowness of response to identification of M-16 problems by testing. A primer compound which contributed to fouling was deleted 3 years after identification of the problem. Other ammunition problems continued to exist at least 5 years after identification. Tests to evaluate specific changes incorporated in the design were not completed as much as 17 months after these changes went into production. Major factors contributing to these difficulties included the original purchase of a limited quantity of an off-the-shelf item followed by a subsequent need for a very large quantity in a very short time. Neither of these situations corresponded to normal Army procurement of a new item, particularly with respect to development and testing. (The rifle was type classified Standard A 3 years after full scale production was initiated.)

d. Many tests appeared to duplicate previous tests rather than providing new data. Testing performed by the Air Force, Marine Corps, contractor, and the Army suffered particularly from this problem. Some of the testing suffered from small sample sizes, so that distortion of results occurred if a single rifle performed abnormally. Since

statistical confidence levels were not reported, these distortions could not be identified. Comparisons were made under different conditions (environment, number of rounds) without use of weighting factors. Major production decisions were made, particularly in the 1964-1965 era, in spite of known deficiencies in the M-16 which had previously been identified by testing.

e. Although it was known that automatic rifle mechanism characteristics were still an empirical science, and that one of the variables in mechanism performance is the cartridge characteristics, changes were made in cartridge propellant formulation without testing for the implications and effects of these changes on rifle performance, particularly cyclic rate. Subsequent testing, initiated and supported by field results, indicated problems caused by high cyclic rates and excessive propellant residue. The contractor was aware of these problems and initiated design changes to correct some of them. Prior to incorporation of these changes, a non-standard propellant type was specified for at least one series of tests so that cyclic limits could be met.

3. Recommendation.

No change in the process should be made at this time. The present acquisition process should provide the necessary visibility to test results so that decision makers will be aware of all significant problem areas.

ANNEX V-A

CHRONOLOGICAL LIST OF TESTING TEAM VISITS

DATE	TEST TEAM PARTICI-PATION	ORGANIZATION CONTACTED	PURPOSE	KEY PERSONNEL
12/18	Full	AMARC	Meeting	Dr. Sell MG Camm
1/14	Full	Secretary of Defense Secretary of ARMY Chief of Staff Vice Chief of Staff CG, TRADOC CG, AMC AMC	Meeting	 Gen. Miley LTG Vaughan MG Pezdirtz Dr. Dillaway MG Meyer MG Sammet
1/15	Select Team Members	AMC/Project Review XM-1 AAH MICV	Briefing	 MG Baer BG S. Cockerham COL McClusky
1/16	Full	OTEA USAF	Briefing Briefing	MG Ochs MG K. Russell
1/28	Full	ECOM, APG, Md.	Briefing	MG Brown BG Smith Mr. Goodwin Dr. Gamble
1/29	Full	OTEA	Briefing	MG Ochs
1/29	Full	AMC/Project Review SAM-D AAH XM-1 M-60	Briefing	
1/30	Full	DDR&E (T&E)	Meeting	LTG Starbird USA (Ret)

DATE	TEST TEAM PARTICI-PATION	ORGANIZATION CONTACTED	PURPOSE	KEY PERSONNEL
1/31	Staff	Dept. of NAVY	Briefing	RADM Woodfin Dr. Peter Waterman
2/1	Mr. Jackson	AMARC	Meeting	Dr. Sell MG Camm
2/11	Staff	GAO	Briefing	Mr. R. W. Guttman
2/15	Full	CDEC, Ft. Ord, Cal.	Briefing	BG Starker COL Hayes
		MASSTER, Ft. Ord, Cal.		MG McChrystal Dr. Dickenson
		AAH, Ft. Ord, Cal.		Mr. C. Crawford Mr. R. Hubbard
		OTEA, Ft. Ord, Cal.		MG Ochs
2/27	Full	US ARMY Inf. Center, Ft. Benning, Ga.	Briefing	MG T. Tarpley BG W. Richardson COL W. Meinzen COL J. Hatch COL Armstrong
2/28	Full	AVCSA	Meeting	LTG Kalergis
2/28	Full	AMC/TECOM, AMC Hq.	Meeting	Gen. Miley LTG Vaughn MG Sammet MG Pezdirtz Dr. Dillaway MG Brown Mr. Goodwin
3/1	Mr. Jackson	AMARC	Meeting	Dr. Sell MG Camm
3/2	Mr. Jackson	SECDEF	Briefing	Sec. Schlesinger Sec. Augustine Sec. Staudt Gen. Weyand

DATE	TEST TEAM PARTICI-PATION	ORGANIZATION CONTACTED	PURPOSE	KEY PERSONNEL
3/22	Mr. Jackson, Mr. Raviolo	AMARC	Meeting	Dr. Sell MG Camm
	Mr. Jackson	USA	Meeting	Sec. Staudt
	Mr. Jackson, Mr. Raviolo	DDR&E (T&E)	Meeting	LTG Starbird USA (Ret)
3/23	Mr. Raviolo	AMC	Meeting	Sec. Staudt Gen. Weyand Gen. Miley Dr. Sell MG Camm

CHAPTER VI
SCIENCE AND TECHNOLOGY TEAM REPORT

A. INTRODUCTION

1. The shortness of study time, the complexity of the issues, and the realization that ours was yet another in a long series of studies dealing with Department of Defense in-house research and development combined to warn us that this study should be approached with a certain degree of caution and restraint. What would most ill-serve the newly appointed Secretaries of Defense and the Army would be bold assertions and recommendations based only on preconceived notions.

2. Accordingly, we have attempted to begin our study with a careful assessment of where the AMC laboratories stand today. And to do that, we have taken note of where they clearly stood some 10 to 12 years ago. During the decade of the fifties and well into the sixties, many of the Army's laboratories were in an inferior position relative to industrial and government-contracted laboratories in the US. The causes for this situation were numerous, but among them were the following:

a. Inadequate Civil Service pay scales.

b. Unimaginative and overly restrictive management by the Army of its laboratory resources.

c. Inept technical direction at many Army laboratories.

d. Conflict between military and civilian sectors of laboratory management.

e. Civil Service practices which sheltered mediocre personnel and frustrated the more talented personnel.

f. Fragmented and ill-defined missions for the laboratories.

g. Second-rate laboratory facilities and equipment.

(Army successes in missile technology and development were among the few exceptions to this largely unsatisfactory situation.)

3. Fortunately, through a combination of circumstances and Army action, very positive progress has been made in the last 10 years. Not all of the problems have been solved by any means, but action by the Congress brought comparability to Civil Service pay scales, and action by the Civil Service Commission (prompted by OSD) eliminated some of the more burdensome Civil Service practices. Examples of positive Army action include:

a. A thorough restructuring of the major subordinate commands in AMC, and realignment of missions to the AMC laboratories.

b. The attempt to integrate laboratories at the commodity commands with commodity command RD&E directorates (still a goal in many cases, but progress has been made).

c. The use of single program element funding (SPEF) to make technology base activities responsive to the needs of the mission-oriented commodity rather than to the whims of a hierarchial bureaucracy.

d. Delegation of increased responsibility to laboratory/RD&E directors, and curtailment of some over-management and interference by OCRD and AMC headquarters' staffs (much more can be attained here, but progress has been made).

e. Imaginative use of project REFLEX to upgrade laboratory competence, as well as to adjust the work force to the mission.

f. Significant upgrading of the quality of technical leadership at Army laboratories.

g. The management of geographically separated efforts in important technical areas under the lead-laboratory concept.

h. Imaginative action such as the collocation with NASA to obtain rapidly a capability in low-speed aircraft technology.

4. The Science and Technology Team believes it extremely important that the Secretaries of Defense and the Army be apprised that significant progress has been made. Although these steps do not yet add up to a totally adequate and efficient utilization of the Army in-house capabilities and technology base in the acquisition of materiel,

collectively they demonstrate a position today far superior to the collection of Army laboratories in the 1950's. At several of the Army laboratories which the team visited, we found responsible technical leadership, a reasonable percentage of young scientists and engineers on the staff, and facilities often as well equipped as those in industrial and contractor laboratories.

5. Before discussing our findings, the Science and Technology Team wishes to comment on four previous studies dealing with in-house Defense laboratories which are particularly pertinent to the current inquiry. These are:

a. The "Bell" Report. This report, undertaken in 1962 at the request of President Kennedy, was prepared under the direction of the Hon. David Bell, Director, Bureau of the Budget. A short report of only 24 pages, this scholarly document explores the whole matter of contracting for research and development by the government, and the state of in-house government laboratories at that time. Its statements on the criteria for contracted operations and on the problems faced by in-house Defense laboratories are applicable reading today.

b. The "Glass" Report. A report, undertaken at the request of the Deputy Secretary of Defense in response to allegations of the Blue Ribbon Panel, and written in 1971 by OSD and Military Department personnel, chaired by Mr. Edward Glass of ODDR&E. The report represents a very detailed examination of many aspects of in-house Defense laboratories: roles, accomplishments, management problems, consolidations, closures, and cross-service activities. The report made 29 specific recommendations for improvement in the areas of mission, administrative environment, and laboratory personnel. Many, but not all, of the recommendations have been acted upon.

c. The "Lewis" Report. A report, separately tasked by DDR&E as a "check" on the findings of the Glass Report, was written by a group of academic consultants to the Institute for Defense Analysis under the chairmanship of Prof. H. W. Lewis. It was much more limited in scope than the Glass Report, but its conclusions, based on independent visits to 10 Defense laboratories, were remarkably similar to those of the more extensive Glass Report.

d. The "Fitzhugh" Report. This report, by the "Blue Ribbon Defense Panel" under the chairmanship of Mr. Gilbert W. Fitzhugh, alleged that the Defense laboratories were costly and unproductive. However, there is no evidence that the Blue Ribbon Panel visited a single in-house laboratory, or held a single hearing of any kind on the subject. The "Glass" and "Lewis" reports refuted the allegations as being simply out of date. Both the "Glass" and "Lewis" reports, although recommending lines of action for substantial improvement, judged the laboratories a valuable Defense resource, of reasonably high competence.

B. DEFICIENCIES AND RECOMMENDATIONS As described in the introduction, the US Army has made significant improvements in its complex of laboratories. In Annex A to this report, some of the current strengths of the Army laboratories specifically noted by the Science & Technology Team during its field visits are described. Significant deficiencies remain, however, and in this section critical findings resulting from the team's visits and discussions are catalogued, followed by a listing of recommendations for action to address these deficiencies.

1. Deficiencies.

a. Laboratory Mission Effectiveness.

(1) Problems and tasks concerned with logistic and readiness missions demand a major portion of most commodity commands' resources and often overshadow materiel acquisition in competition for management attention.

(2) Significant segments of the total work program carried out by many Army in-house laboratories are not effectively directed toward support of Army missions. Work performed consists of a mixture of assigned missions as well as self-generated programs and solicited projects. The proportions vary at different activities. Sometimes the program mixture is substantially influenced by self-interest and professional survival.

(3) AVSCOM is currently performing its major engineering mission at headquarters in St. Louis, widely separated from its R&D establishments and without the benefit of facilities to allow for hands-on technical activities. This greatly handicaps their system integration capability and provides limited opportunities for maintaining

the skills of the approximately 300 development engineers at St. Louis. The Command is planning to organize an R&D Directorate to facilitate the work and tasking flow from R&D to engineering.

(4) The systems mission responsibility of AVSCOM does not include appropriate life-cycle authority over all subsystems. All air/ground avionics development is currently programmed and conducted by ECOM's Avionics Laboratory. Although AVSCOM has the mission for procurement and materiel management of aerial delivery equipment including parachutes for both cargo and personnel, the Army RD&E in this area is carried out at Natick Laboratories' Airdrop Engineering Laboratory. The CG, AVSCOM, has some influence in these developments but does not consider himself in an adequate position to either task or control these programs commensurate with the overall responsibility of AVSCOM's mission.

(5) Small-caliber weapons and munitions development is fragmented between Frankford and Rock Island Arsenals. The Army's small-caliber weapons are developed at Rock Island Arsenal and the ammunition and fire control at Frankford Arsenal, with attendant lack of coordination resulting from separation in responsibility and geography.

(6) Rock Island's Rodman Laboratories are not adequately endowed to perform the Army's weapons R&D program. The R&D assets at Rock Island's Laboratories are ineffective for building the required conventional weapons technology base.

(7) Frankford Arsenal does not have responsibility for any system research and development project; its many small and somewhat unrelated efforts fail to provide a sense of overall purpose. In several laboratories, e.g., MICOM Laboratories, Edgewood Laboratories, Feldman Laboratory (Picatinny Arsenal), and Night Vision Laboratory, it was very obvious that good leadership merged with significant mission assignments resulted in a productive environment.

(8) The assignment of the exclusive "electronics" missions to ECOM increasingly detracts from effective system integration. Most Army systems need integrated or modular electronic subsystems, for which design expertise must be locally provided. The extensive spectrum of research, development and commodity responsibility,

which has evolved over the years at the Electronics Command, has tended to defocus this organization's responsiveness to modern, mission-oriented needs, especially in the areas of electronic warfare, combat surveillance, and avionic systems.

(9) The current TACOM Mobility Systems Laboratory does not provide adequate potential for innovation in vehicular concepts and components. Current TACOM Laboratory manpower and facilities are more attuned to functioning as an engineering and test shop for field and production problems than for research on new concepts.

(10) The TROSCOM approach to the RD&E portion of the life-cycle management mission gives the impression of being overstructured in relation to the small number of new items being type classified. The Command handles logistics for a very large number of small individual items and is attempting to become familiar with many new commodities added to the mission on 1 July 1973. The management concept, based on Federal Supply Classes, is driven by the vast logistic function of this Command, and overshadows the attention that is deserved by the R&D and materiel acquisition mission.

(11) The Tri-Service Food RDT&E Program, which is approximately one-third of the total effort at Natick Laboratories, appears to be beset by programming and management problems although the R&D is carried out with commendable effectiveness. The assignment of Natick to TROSCOM in July 1973 apparently contributed to further confusion, due primarily to the short time which the new command has had to develop the expertise and understanding of this specialized program. Furthermore, the formulation of the DOD program itself through the Joint Formulation Board has also had some very serious problems of coordination in the immediate past. The relationship of the Laboratory to the Joint Technical Staff was also a problem area which has been recognized. Currently, "managers" of the DOD food products are also the designated laboratory directors.

(12) The Harry Diamond Laboratories and the Materials and Mechanics Research Center represent two typical R&D facilities whose capabilities and high-level potential are currently not adequately exploited in contributing to the Army's materiel mission. An underlying cause for this hesitancy on the part of some commodity command laboratories to avail themselves of all needed services was sensed

to be a fear of poor reflection on their expertise or an anxiety of jeopardizing their own "mission" responsibilities.

b. Laboratory Management Problems.

(1) For most laboratories there is inadequate interaction with the user. Often the laboratory thinks of the user as the creator of the requirement which initiates their program and thereafter as a factor to be tolerated. As a result, some promising ideas lead to impractical systems not well matched to field use, while other good ideas are often stifled because development managers claim, "There is no immediate requirement." Some laboratories have commendable programs of interaction with the user (TACOM's informal but productive working relation with the Armor Center, for example) whereas others, in some cases for lack of full-system responsibility, have not developed meaningful user relationships. Yet, the team sensed a progressively increasing appreciation of the value of real-world experiences in the equipment development process.

(2) The utilization of other defense or government laboratories was generally very limited. Excellent examples of good usage were found in MICOM's liaison functions with AEC and Air Force, and AVSCOM's excellent cooperative effort with NASA R&D personnel and facilities. The equipment managers often have difficulty in identifying all applicable technical data and expertise in other laboratories. In general, managers in the laboratories do not appear to question critically the extent to which a specific R&D requirement could be or has been accomplished in other laboratories.

(3) There is widespread agreement on the virtues of being able to evaluate laboratories; however, there is no known standard procedure for the qualitative and quantitative measurement of the output of Army laboratories. The difficulties of such measurements were reported almost everywhere, although individual laboratories have devised a variety of methods (mostly subjective) to assess their relative merits in particular project areas. Measures to date have included some or a combination of the following:

(a) Milestones accomplished.

(b) Objectives achieved.

(c) Accomplishment of work-break-down tasks.

(d) Number of concepts transferred to approved project level.

(e) Number of items type classified.

(f) Frequency of customer return business.

(g) Inspection, review, discussion of tasks.

(h) Cost-schedule-control-system criteria.

(4) The translation of in-house laboratory-created ideas--not specifically solicited--to potential Army concepts is at best difficult and generally poorly defined. In those exceptions where knowledgeable military personnel are integrated into the laboratory staff and can serve as "idea-to-concept" translators, the opportunities for success have been markedly improved. Innovations and creative concepts are not programmable but should be considered as very precious commodities; nevertheless, the majority of the laboratories do not have satisfactory means to either encourage or promote them through higher echelons.

(5) The constraints imposed by government and Army manpower regulations often frustrate effective management of laboratories and arsenals. Some commodity commands, with REFLEX, have had superimposed upon them both manpower ceilings and reductions in average grade with very serious effects on the retention of "new blood." This is further complicated by lower entrance salaries for scientific and engineering personnel in government compared to industry. Many organizations report seriously distorted capabilities after having been subjected to manpower reduction or RIF selection-out processes. The efficiency of in-house activities is often damaged by the imposition of independent mandates on manpower, tasks, and funds.

c. <u>Decision Layering</u>.

(1) The delay in planning, programming and funding decisions continues to impede an effective research and development effort. The layering of decision makers and the large attendant effort to make multiple presentations and justification have frequently resulted in serious delays, additional costs and frustration. Both real and "artificial" managers have contributed to the decision paralysis

at most levels, including staffs at commodity commands, AMC, DA, DDR&E, and other OSD elements. The regulatory process is judged to be too heavily biased toward avoiding mistakes rather than achieving effective output.

(2) It is probably true that OSD, in monitoring Army performance and in attempting to bring about a proper coordination of activity between the Services, all proper OSD functions, has encountered conflict situations which required OSD action. Nevertheless, the Secretary of Defense could make a significant contribution to the eventual strength and capability of Army RDTE establishments by defining clearly and concisely the proper functions of what basically is the Defense Department's Corporate Board, and then limiting, by vigorous action if necessary, the large OSD staff to just these functions. It is remarkable how unclear it is at both OSD and Army levels as to just what are OSD's proper functions.

(3) The Army materiel acquisition regulation, AR 1000-1, should remain in effect and be allowed to mature further, prior to a critical evaluation. Some fine tuning is probably desirable, but basically AR 1000-1 needs to be applied with more imagination and less preconceived rigidity. To date, the tailoring of the acquisition process to particular materiel permitted by this regulation has often not been adequately exploited.

d. Technology Base Maintenance. As shown in Annex B, there is a continuing trend of erosion (as measured in constant dollars) of funding the Army's technology base (research and exploratory development). The technology base in several critical Army mission areas, e.g., munitions, weapons, target acquisition, EW, etc., is in need of replenishment to provide viable options for future materiel acquisitions. Crash efforts on behalf of Vietnam have taken a heavy toll on the research base. The current trend toward broader research funding through single program element funding (SPEF) has proven productive by permitting managers to employ such funds most effectively in reinforcing success and terminating unrewarding efforts. We also found widespread success in the "In-House Laboratory Independent Research" program which is building substantial confidence in the research management at the laboratory-director level.

e. Procurement Obstacles.

(1) The regulations governing purchases of computers[1] create severe delays, impacting on ability of laboratories to accomplish their missions in the most efficient and cost-effective manner. Delays experienced in procuring large scientific computers have run an average 5-6 years with single best experience of 3 years. Mini-computers costing $25,000 to $40,000 also fall under these special regulations. It has in some cases taken over one man year of effort (at $40,000 per man year) to justify, pursue, and finally secure a $25,000 mini-computer for use in test equipment to take over manual functions for purposes of reliability and economy.

(2) The current small purchase limit of $2,500[2] has not been increased with inflation with detrimental results for the day-to-day operation of laboratories. Purchases from $2,500 to $10,000 must be made by contract with more detailed preparation, justification, review and with greater scope of competition than small purchases. If speed is critical, total requirements get divided--whether permitted or not--compounding the workload of technical personnel, typing, fund commitments, negotiation, shipping and receiving, paying, stocking, etc. One installation estimates small purchase order volume could be reduced by 50% if the dollar limit of small purchases is raised to $10,000.

(3) The $100,000 threshold[3] for furnishing Determinations and Findings (D&Fs) to Army secretarial level for R&D contracts is unreasonable and is involving more and more procurement actions since this amount has not been adjusted upward with inflation. The delay and staffing effort at all levels to prepare and review D&Fs entails a large overhead cost disproportionate to the monetary value of the D&F.

f. Risk Management. "Risk Factors" are frequently not seriously integrated or not recognized early in the life-cycle management of systems. Laboratory directors admit that giving full credit to risk potential is not advantageous to "selling" the program, not

---

[1] Public Law 89-306, DOD Directive 4105.55, AR 18-1.

[2] Title 10 US Code 2304(a)(13), promulgated in Armed Services Procurement Regulations (ASPR).

[3] Established in 1962, Title 10 US Code 2311, promulgated in ASPR.

popular with project leaders, not well received by next higher headquarters or project manager customers, not well analyzed and articulated in the first place, and in need of being taken much more seriously by the total development process. Many of the cost, quality, and delay problems of well-publicized failures in past major systems are traceable to over-optimistic estimates and negligent risk planning.

2. Recommendations.

a. Major Recommendation. The Army should evolve toward consolidation of its AMC laboratories into mission-oriented development centers for RD&E and materiel acquisition, with the logistic and readiness functions performed in logistic centers. In addition to laboratories, the development centers would also contain consolidated installation and commodity command RD&E elements, project managers, support elements, selected user elements, and command elements. A separate section (Section C) is devoted to a more detailed description of this major recommendation.

b. Additional Recommendations.

(1) Assign combat officers with appropriate experience to act as consultants on user aspects of the program at development centers. The user must actively continue to relate to the materiel throughout the total development cycle; also, scientific and engineering personnel should be deliberately exposed to more contacts with operational exercises and tests. The recommended development centers provide for inclusion of select user elements in the basic organizational nucleus in order to facilitate the integration of system development and field deployment.

(2) Make better use of other government laboratories. Management check points should be established to assure that consultation in coordination with other Army, Defense or Federal laboratories is not overlooked in planning R&D tasks. Exploitation of "other sources" should be more openly practiced in the development center environment, since assignment of a major mission should remove much of the anxiety associated with "losing" the program.

(3) Evaluate development centers systematically and regularly. AMC should continue to appraise the "worth" of the new Army development centers. The futility of searching for standardized

evaluation "measures" should be recognized. Any such evaluation system is vulnerable to being "played" to make a poor organization look good. Nevertheless, AMC should evaluate the performance of its centers with the powerful managerial tool of good judgment based on adequate consultation with informed and unbiased people.

(4) Maintain climate for innovation. Innovation useful to the Army should be encouraged. Middle management especially should be advised that the absence of a specific Army requirement does not, in itself, suffice to justify the termination of a research or exploratory development effort. However, the absence of any conceivable Army application should continue to require the termination of a research or development effort.

(5) Try harder to overcome the Civil Service constraints.

(a) To reform the constraining Civil Service practices[1] requires concentrated action by the Secretary of the Army to insure that internal Army practices do not make the situation even more restrictive than Civil Service regulations allow. In addition, the Secretary of Defense must work in a vigorous and a positive way with the Congress and with the Civil Service Commission to seek needed reforms in Civil Service.

(b) Special teams consisting of selected personnel experts and successful R&D directors and managers should visit Army installations to train and advise R&D managers on successful ways of dealing with Civil Service manpower problems. Such teams could also advise OSD on specific Civil Service problems and reforms which would serve as the basis of DOD proposals to the Congress or the Civil Service Commission for change.

---

[1]Civil Service restraints and manpower management practices within the Army effectively serve to separate the directors of Army R&D facilities from control over the management of their personnel resources. As a result, the hiring process is too slow, personnel movement (involving work assignments and termination for cause) is unduly restricted, and the composition and size of the work force is dictated by arbitrary ceilings, averages, and pay scales rather than by the needs of the R&D facility. Relief must also be sought from current Civil Service inflexibilities in the selection-out procedures during RIF situations and other personnel reduction programs. The objective

(6) Consider possibilities of contractor operations at development centers. If Civil Service restrictions and internal Army problems should continue to interfere with the attainment of high-performance Army development centers, the Army should explore the possibilities of contractor operation.[2] Elements of the proposed Armament and Ground Mobility Development Centers are, in our view, the most likely candidates.

(7) Reduce decision layering. We believe that depopulating and reducing the number of layers of managerial supervision overlying R&D workers would, on balance, reduce costs and reduce the frequency and severity of development failures. The management functions to be performed by the various management levels must be much more accurately defined in order to streamline administrative and approval procedures. Briefings and justifications shall be combined whenever possible if similar information must be imparted to various echelons. Specifically, for major Army systems, the decision point should be the ASARC, and a small DOD representation should attend these ASARC's in place of separate follow-on DSARC's.

---

must be to obtain efficiency by weeding out the low-producers, rather than the current experiences of obtaining "trimmed-down" organizations with distorted capabilities.

[2]Contracted R&D operation by the US Government has been the subject of much study and experience. As mentioned previously, the "Bell" report deals with the subject at some length, and succinctly describes the criteria which should be met for contractor operation. When these criteria are met, the operations are generally successful, and a number of government agencies (DOD, AEC, NASA, etc.) have examples of high performance RD&E establishments which are contractor operated, some for 25 years or more. Most of these organizations started as contracted operations. There are few, if any, examples of in-house federal laboratories being converted to government-owned contractor-operated (GOCO) facilities. We do not underestimate the difficulty of the conversion. Selection of the contractor, resolution of the pension rights of federal employees transferring to the contractor, ASPR regulations and integration of military personnel into the contractor operation are just a few of the many problem areas. However, we note that solutions to these problems are known and that the flexibility of contractor operation might serve the Army well over the long term.

(8) Maintain the technology base. Army decision makers need to be more aware of the need for maintaining a constructive technology base in order to assure the future effectiveness of Army's weapons and materiel. In order to stop the current trend of funding erosion of one-third in real dollars in 10 years, a more agressive and positive approach needs to be taken with OSD and the Congress for 6.1 and 6.2 funding. "Single Program Element Funding" for research and exploratory development should be expanded to all programs.

(9) Delegate authority to AMC to lease or buy laboratory computers. The authorization for purchases of scientific and laboratory computers should be divorced from the acquisition of general purpose, business and other automatic data processing machines. Approval authority for the computers needed by the laboratories should be delegated to AMC up to $200 000 annual lease or $500,000 purchase.

(10) Raise procurement dollar thresholds to keep pace with inflation. The funding threshold for R&D contracts requiring Army Secretarial D&F approval should be raised to $250,000 from the current $100,000 level. The current "small purchase" limit of $2,500 should be raised to $10,000.

C. RECOMMENDED PLAN FOR EVOLUTION TO DEVELOPMENT CENTERS

1. General Overview.

a. The proposed concept for restructuring the in-house Army laboratory activities arises from the findings based on our visits to nearly all R&D activities (See Annex C). Although the present commodity command structure has just been reorganized within the last year and insufficient time has passed to determine its merits, we feel that more comprehensive changes are required in the materiel R&D process. This plan is specifically intended to increase the quality of the Army's materiel and maintain a substantive readiness posture with reduced personnel and resources.

b. It is the explicit goal of this plan for AMC to build its weapons and materiel acquisition process on the development center concept, with separate logistic centers for the logistic readiness mission. The research, development, and initial production buy of systems and equipment would be carried out by six development centers

with coherent major mission responsibilities. We believe efficiency requires that the number of logistic centers be significantly smaller than the number of development centers.

c. We consider the development center concept essential in order to capitalize on the success stories both in government (including the Army) and the private sector that result when challenging missions, capable people, and energetic management are functioning in the same environment. The evolution into development centers by the consolidation of laboratories, RD&E elements from installations and commodity commands, project managers, related user elements, support elements (to include dedicated procurement and civilian personnel offices), and command elements will remove the geographic barriers which now exist in several commodity command headquarters and laboratories. This consolidation, particularly for those activities now fragmented, will maximize the utility of AMC's RD&E resources, including the many exceptionally qualified scientific and engineering personnel, and ultimately should provide the following advantages:

(1) More effective "critical mass" of technical talent, expediting consultation, broadening career opportunities, and facilitating civilian personnel management.

(2) Large demanding missions challenging the work force, providing them a sense of valuable contribution, stabilizing installation funding fluctuations, and minimizing invention of insignificant "job security" efforts.

(3) More effective equipment being fielded at less overall cost resulting from reduced in-house manpower, closer coordination of subsystem developments, savings in travel expenditures, and more efficient transfer of systems technology to industry.

(4) Substantially faster response to intensified needs or critical problem areas due to greater flexibility of scientific and engineering resources.

(5) Expanding opportunities for innovative and creative ideas to surface for potential military application.

(6) More realistic estimating of program options, risks, performance and schedules by more effective coupling of internal expertise to the acquisition process.

(7) Reduction in overhead costs resulting from shared and more fully utilized support activities, such as security, safety, quality assurance, drafting and machine shops.

d. The Army's armaments program is a particularly good example to illustrate these benefits which could be derived by consolidation into a development center.

(1) In the armaments area, research and development is fragmented among four arsenals. Small arms are at Rock Island, small caliber ammunition at Frankford, large caliber tubes at Watervliet, and large caliber ammunition at Picatinny. The problems concerned with technical coordination of developments, efficient management of resources and personnel, and imparting a sense of challenge and purpose result, in large measure, from the existing geographic fragmentation of effort.

(2) Consolidation of small arms weapons with the ammunition and consolidation of large caliber tubes (and carriages) with large caliber ammunition are both clearly indicated to achieve design and development coordination. Additionally, there are many common disciplines to both small and large caliber systems, such as propellants, ballistics, and metallurgy, which indicate further opportunities to be gained from complete consolidation.

e. We do not wish to imply that there are no "costs" associated with the attendant missions realignment and relocation activities which the implementation of these recommendations would require. It must be anticipated that temporary difficulties, delays, dollar outlays and personnel dislocation problems will be encountered. In fact, the recommended plans will also invoke political reactions as well as some serious employee resistance. To find effective and equitable solutions to these organizational and facility problems will be a continuing and challenging task of Army management.

f. It is recognized that the full implementation of the proposed concept will require the preparation of more detailed plans and a deliberate will on the part of management in order to achieve its goals; however, the effort should result in rewarding dividends for future combat effectiveness of the Army, especially in an environment which compels increasing productivity with reduced resources.

2. Outline of Development Center Concept. TABLE VI-1 on the following page lists the six recommended development centers and illustrative major mission areas, together with possible consolidations of in-house laboratories and RD&E activities for evolution into these centers. Further details regarding TABLE VI-1 are provided below in paragraph 4, Recommended Implementation Steps. There will be minor differences in approach depending on the mission area, but it is expected that the essential makeup and function will be similar for all centers, with each striving to have as many of its elements collocated as possible.

a. The commanding officer of a development center could be either military or civilian. The prime objective should be to obtain the best qualified manager. For civilian commanders of development centers, a limited term of service should be established with options for renewal. Consideration should also be given to including more young military officers in the development centers to provide better coordination with the military community and to furnish a supply of potential leaders for subsequent assignments in the materiel development process.

b. Each center will be assigned responsibility and authority for all systems, equipment, and materiel in a major Army mission area. (i.e., Air Mobility Development Center would include the missions for air mobility, Army air operations, airborn and ground avionics, applicable aircraft technology.)

c. The development centers will become operationally self-sufficient, mission-responsive, equipment development organizations which facilitate the utilization of in-house expertise and enhance the interaction with industry. Eventually, the identity of individual laboratories will be absorbed in the center's RD&E activities, so that mission programs and research tasks can be more flexibly assigned to appropriate center elements.

d. The materiel acquisition mission of each center will span from 6.1 research at least through the "first production buy," and it will also include militarization of commercial equipment and major product improvements.

e. The centers are expected to institute management procedures which provide for effective utilization of out-of-house capabilities (other Federal laboratories, industry, nonprofit centers, etc.)

TABLE VI-1 - CONSOLIDATION OF LABORATORIES AND RD&E ACT

DEVELOPMENT CENTERS	GROUND MOBILITY	AIR MOBILITY	ARMAMENT	
ILLUSTRATIVE MAJOR MATERIEL MISSIONS	Ground Vehicles Tanks Materials Handling Equipment Earth-Moving Equip Propulsion & Suspension Tech	Air Mobility Tech Rotary Wing Tech Army Air Operations Air/Ground Avionics Air Delivery Equip Drones	Weapons & Wpn Sys Nucl & Conv Ammo Fire Control Equip Mines, Grenades Pyrotech, Smoke Chemical Materiel Def Bio & Rad Mats	Fr Gu Ba Ai Mi Gu

RD&E ACTIVITY CONSOLIDATIONS:

TACOM RD&E DIR
MOBILITY SYSTEMS LAB

AVSCOM RD&E DIR
AIR MOBILITY R&D LAB

ARMCOM RD&E DIR
BALLISTICS RESEARCH LAB
EDGEWOOD ARSENAL
FRANKFORD ARSENAL
PICATINNY ARSENAL
ROCK ISLAND ARSENAL
WATERVLIET ARSENAL

MISSILE RD&E LAB

TROSCOM RD&E DIR
MERDC
NATICK LAB
HARRY DIAMOND LAB
COMBAT SURVEILLANCE
NIGHT VISION LAB

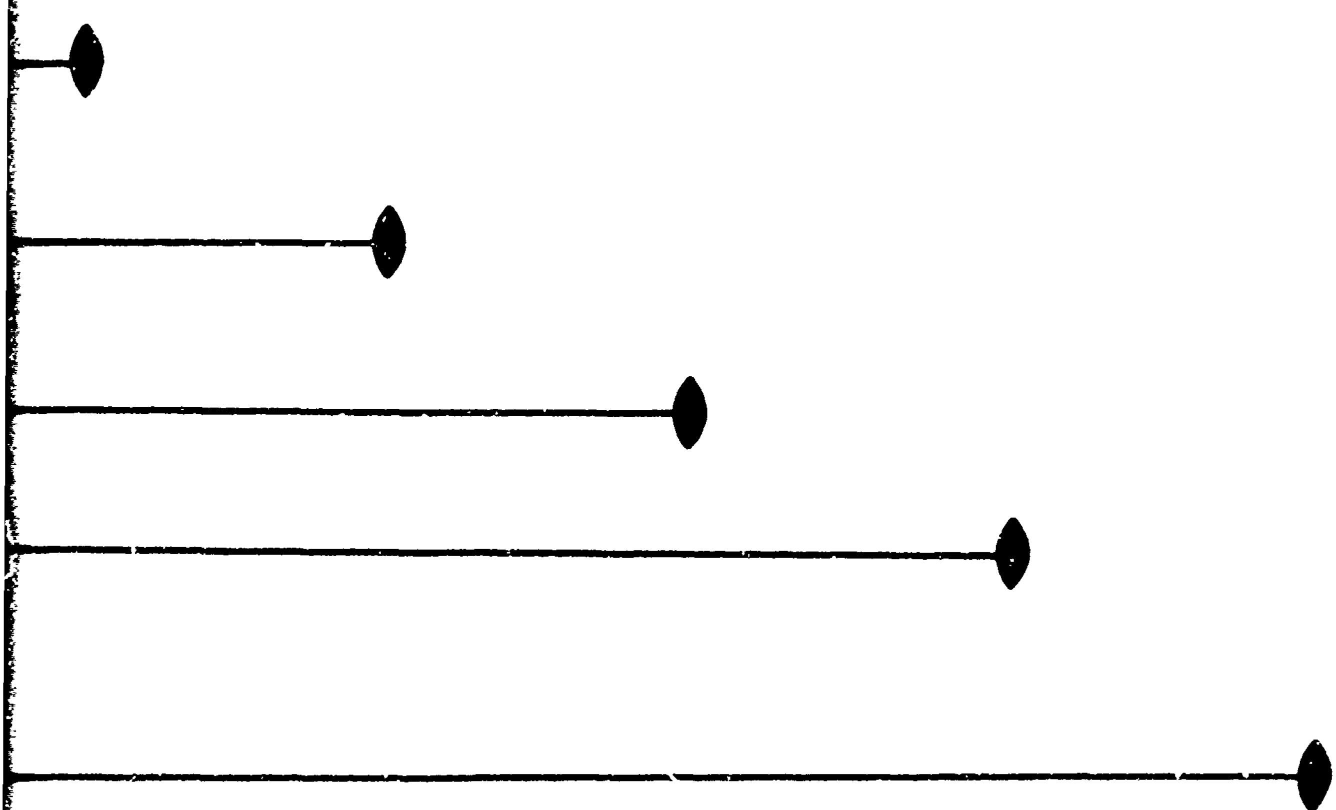
ECOM RD&E DIR
COMMUNICATIONS ADP LAB
ELEC TECH & DEVICES LAB
ELEC R&D TECH SPT ACT
SATCOM RD&E ELEMENTS

MATERIALS & MECHANICS
ELECTRONIC WARFARE
ATMOSPHERIC SCIENCES

NOTE: See paragraph C4 for specific recommendat

ON OF LABORATORIES AND RD&E ACTIVITIES INTO DEVELOPMENT CENTERS

MOBILITY	ARMAMENT	MISSILE	COMBAT SUPPORT	COMMUNICATIONS
obility Tech	Weapons & Wpn Sys	Free Rockets	Food & Food Systems	Tactical Communi-
y Wing Tech	Nucl & Conv Ammo	Guided Missiles	Clothing	cations
Air Operations	Fire Control Equip	Ballistic Missiles	Life-Support Equip	Strategic Communi-
round Avionics	Mines, Grenades	Air Defense Msls	Countermining	cations
livery Equip	Pyrotech, Smoke	Missile Fire Control	Counter Surveillance	Satellite Communi-
s	Chemical Materiel	Guidance Technology	Surveillance/Sensors	cations
	Def Bio & Rad Mats		Navigation Systems	ADP Equipment
			Night Vision	IFF Systems
			Camouflage	



paragraph C4 for sp ~ recommendations.

and guide the in-house work-load in accordance with the following seven principles (these are similar to those now published by AMC for laboratory operations):

(1) Carry out research, exploratory development, and innovation of hardware in areas of interest to the development center mission.

(2) Specify and manage RD&E programs conducted by industrial contractors, other development centers, government laboratories, etc.

(3) Develop (and actually produce) hardware in areas where there is neither industrial capability nor interest.

(4) Contribute to the Army's capability as an educated customer of weapon systems and serve as an informed technical interface with industrial or other hardware developers.

(5) Provide in-house expertise for quick reaction to critical problems.

(6) Provide continuity and "memory."

(7) Perform appropriate training of military personnel who will subsequently serve as instructors in the use of newly developed materiel.

f. Where special RD&E needs can best be performed at a center other than the mission center charged with the execution of a task, such service shall be obtained from the activity best suited to fill the need.

g. Each development center will maintain and update technical data packages (TDP) throughout the materiel life cycle. Furthermore, centers will have the duty to interface with the appropriate logistic center, and particularly with their production engineering staffs, to assure coordination of programming and smooth transfer of technology and documentation. Even after the TDP is passed to the related logistic center for purposes of follow-on production, the appropriate personnel and resources of a development center should be available to support urgent or unusual production problems which arise.

On the other hand, it is expected that the logistic centers will feed back to the development centers all actions which require changes to the TDP (such as continuing maintenance problems, equipment failures, etc.).

h. Each development center must assure by management control and periodic review that a meaningful mission technology base (6.1, 6.2, and 6.3a) is appropriately scaled and effectively executed, and that reasonable protections are available to prevent erosion from other responsibilities of the development center.

3. Additional Organizational Considerations.

a. The Team perceives the need for separating the logistic readiness mission from the material acquisition process. Examples of functions which should not be performed at the development centers are:

(1) Procurement of follow-on production (except when the development center is still proving technical data packages).

(2) Operating the national inventory control point (NICP).

(3) Operating the national maintenance point (NMP).

(4) Providing for depot maintenance overhaul.

(5) Operating arsenal and GOCO production facilities.

(6) Planning for production base mobilization.

(7) Providing for materiel transportation.

(8) Providing for obsolete system disposal.

b. AMC is expected to remain as the responsible headquarters for the management of the full system life cycle; however, the character, size and staffing of this organization would need to be adjusted in order to meet its new role. It is recognized that AMC Headquarters, under this concept, will be the level to integrate the materiel life cycle management between development centers and logistic centers. This fact should be considered in adjusting the staff and reordering of tasks within AMC Headquarters to insure appropriate broad direction to these centers and to insure that conflicts can be resolved at a level

below the AMC commander. The current AMC commander's thrust for decentralization should be reinforced to minimize AMC decision making at the individual project level. The planned elimination of the corporate laboratory structure and the delegation of laboratory-type activities to the development centers will also eliminate the need for a "Deputy for Laboratories" at AMC. AMC should establish a new position to assist the commander in maintaining cognizance over 6.1, 6.2, and 6.3a activities. It is considered essential that this new position be dedicated to a strong professional involvement in the planning and promotion of a viable technology base for future Army needs, to include the maintenance of an AMC base of highly competent scientific and engineering personnel with appropriate technological facilities.

4. Recommended Implementation Steps. For implementation of the development center concept, the major events listed below are recommended for Army consideration. Some of the actions in this concept have been anticipated in AMC's current planning. With the time and resources available for the AMARC study, it has not been possible to perform the detailed analyses necessary to support final decision; however, based on visits to the laboratories and commodity commands, the actions suggested have emerged as the most likely candidates for possible implementation.

a. Create a new Armaments Development Center at a single location, through an evolutionary process, by consolidating selected elements of Frankford, Picatinny, Rock Island, and Watervliet Arsenal RD&E activities together with the Ballistics Research Laboratory and portions of the ARMCOM RD&E Directorate. Promote innovation and excellence by careful selection of location for attractiveness to high-caliber professionals, availability of adequate facilities and real estate, proximity to academic institutions, and accessibility to transportation, in addition to detailed cost considerations. Incorporate Edgewood Arsenal missions without relocation. Retain minimum essential engineering functions at the other arsenals to support required production activities.

b. Establish a Communications Development Center by consolidating the Communications ADP Laboratory, Electronics Technology and Devices Laboratory, Electronics R&D Technical Support Activity, SATCOM RD&E elements, and portions of the ECOM RD&E Directorate.

c. Evolve to a Combat Support Development Center in the Washington/Ft. Belvoir area by assigning Harry Diamond Laboratories the additional missions of combat surveillance and target acquisition, and consolidating with Night Vision Laboratory, Mobility Equipment Research and Development Center (MERDC), Natick (without relocation), possibly Human Engineering Laboratory (HEL), and minimum elements from TROSCOM RD&E Directorate. (Evaluate HEL for retention at the Development Center with service to all centers, or for disestablishment and distribution among the centers.)

d. Appoint a project manager for the Tri-Service Food RDT&E Program located at Natick to report directly to AMC.[1]

e. Evolve to an Air Mobility Development Center at Moffett Field, California, as a long-term goal by consolidating the AVSCOM RD&E Directorate, the Air Mobility R&D Laboratory, and an engineering and systems integration facility. Early actions to support this evolution would be: (1) the consolidation of the Eustis Directorate mission with other portions of the Air Mobility R&D Laboratory which are now collocated under cooperative agreements with NASA, (2) the transfer of the airdrop equipment R&D mission from Natick to AVSCOM, and (3) the transfer of the Avionics R&D mission from ECOM to AVSCOM.

f. Create the Ground Mobility Development Center by modifying the mission of the existing TACOM Laboratory to establish (1) a government-staffed engineering and test facility and (2) a contract-operated R&D facility.

g. As a long-range goal, adapt the Missile Research Development and Engineering Laboratory to the development center concept.

h. Transfer the Electronic Warfare (EW) Laboratory and mission to the Army Security Agency (ASA), except that AMC should retain the electronic counter-counter-measures (ECCM) and vulnerability activities for missiles, communications, and non-communication systems. ASA should be directed to avoid the subordination

---

[1]It has been suggested that Natick become a federal laboratory reporting to DSA or DDR&E. The Team does not see this as a short-term solution. The other two-thirds of Natick's activities are in support of and should remain in the Army. The Team does not believe that a development laboratory can or should be integrated into either DDR&E or DSA.

of electronic countermeasures programs to the needs and conveniences of intelligence gathering. ASA's performance in this respect should be closely monitored because the overall Army effort in EW has long been in need of strengthening.

i. The Army needs to examine the role of the Atmospheric Sciences Laboratory (ASL) critically. It is not clear why the Laboratory has operational and R&D missions or even if all the assigned programs are vital to the Army. Based on the current state of the Team's information, the following alternative arrangements are suggested: (1) Integrate ASL with a development center or (2) integrate the R&D activity with a development center and the operational test support teams with TECOM.

j. Services of the Materials and Mechanics Laboratory would be available to all centers similar to current practice. Although an eventual integration with a development center should be planned, the laboratory would report directly to AMC until a phase-over to a specific center is justified.

ANNEX A
ARMY LABORATORY STRENGTHS

1. Laboratory Leadership: Probably the most important strength of Army laboratories is the outstanding leadership, both civilian and military, encountered at many installations. In spite of all the frustrations of late funding, micromanagement by higher headquarters, average-grade reductions, Civil Service regulations, repeated justification of programs, and the general high viscosity of the system for getting things done, some laboratories continue to demonstrate outstanding performance and attitudes of enthusiasm. While changes to reduce the frustrations would contribute to greater efficiency, we firmly believe that the key to successful laboratory operation will continue to be capable, dynamic leadership combined with an important, challenging mission.

2. Management at MICOM Laboratories: At MICOM, we found an attitude of enthusiasm and pride. A special "new concepts team" headed by a colonel is used to translate new technology into useful military applications. The resulting development programs are then often managed by military professionals to enhance interaction with the user and gain the benefits of matrix management, a technique for dedicating selected members of the functional organizations to the required interdisciplinary teams. "Marketing" is pursued at various levels in a commendable effort to insure appreciation of new technology. Liaison officers with the USAF and AEC and advisory panels are well used both to gather and disseminate new technology and concepts.

3. Management at HDL: Professional leadership and management of the workforce at HDL was impressive by its very simplicity and lack of layering. The rotation yearly of 5% of the workforce, including laboratory chiefs, among the ten laboratories continuously enhances professional development, internal communications, and productivity. HDL has also created a highly responsive and flexible laboratory staff which can engage in a "team approach" to problems on very short notice.

4. Management Innovation at AMMRC: At the Army Materials and Mechanics Research Center, there has been a management innovation in putting order and relationship into a great multitude of small but critical efforts in materials through the use of "spider charts." This innovation intelligibly relates major mission activities of the Army to the individual material efforts assisting both the rapid exploitation of developments and the ability of management to apply priorities intelligently within the program.

5. Selection of New Civilian Personnel: Many laboratories have developed variations of apprenticeship programs for hiring new people: some use summer hires (college students) and selectively hire the most promising on their graduation; some make special efforts to hire selected ROTC commissioned officers from all regions of the nation on completion of their obligation (at least one laboratory even tries to marry the selected officer to a local girl to keep him in the area); almost all laboratories make use of the intern program. The wide use of some form of apprentice program is commendable and particularly important in view of the long process entailed in elimination of marginal producers.

6. Advisory Panels: Advisory panels and special consultants are being used by many laboratories with great effectiveness. Panels provide a disinterested sounding board for the laboratory director to help insure that research and exploratory development efforts are meaningfully directed. Such panels have broadened the technical base of the laboratory at little cost; and, with the selection of members who advise other services and agencies, they have also provided a very useful interchange of ideas and catalyzed productive interagency contacts.

7. Lead Laboratories: The "Lead Laboratory" concept is a commendable approach to insure that closely related efforts in new technology areas at various laboratories are coordinated to reinforce each other and avoid unintentional duplication. The use of this concept would be expected to diminish, however, as these efforts are consolidated, over time, in one or a few centers.

8. Exploitation of Foreign Development: The "not invented here" (NIH) syndrome was conspicuously absent at MERDC where advantage has been taken of both Soviet and British bridging developments. Although it was necessary to "reverse engineer" the Soviet floating bridge, the total development cost was a small fraction of what the cost would have been for a comparable original effort. These efforts are exemplary of the innovation and imagination which should characterize the approach to the development process.

9. Modeling: The AMC laboratory system, in general, has made meaningful progress in the last five years toward translating concepts to "modeling." The demonstration of techniques through relatively simple laboratory models, or by adequate simulations, has assisted the decision makers in early evaluation of various options. This is

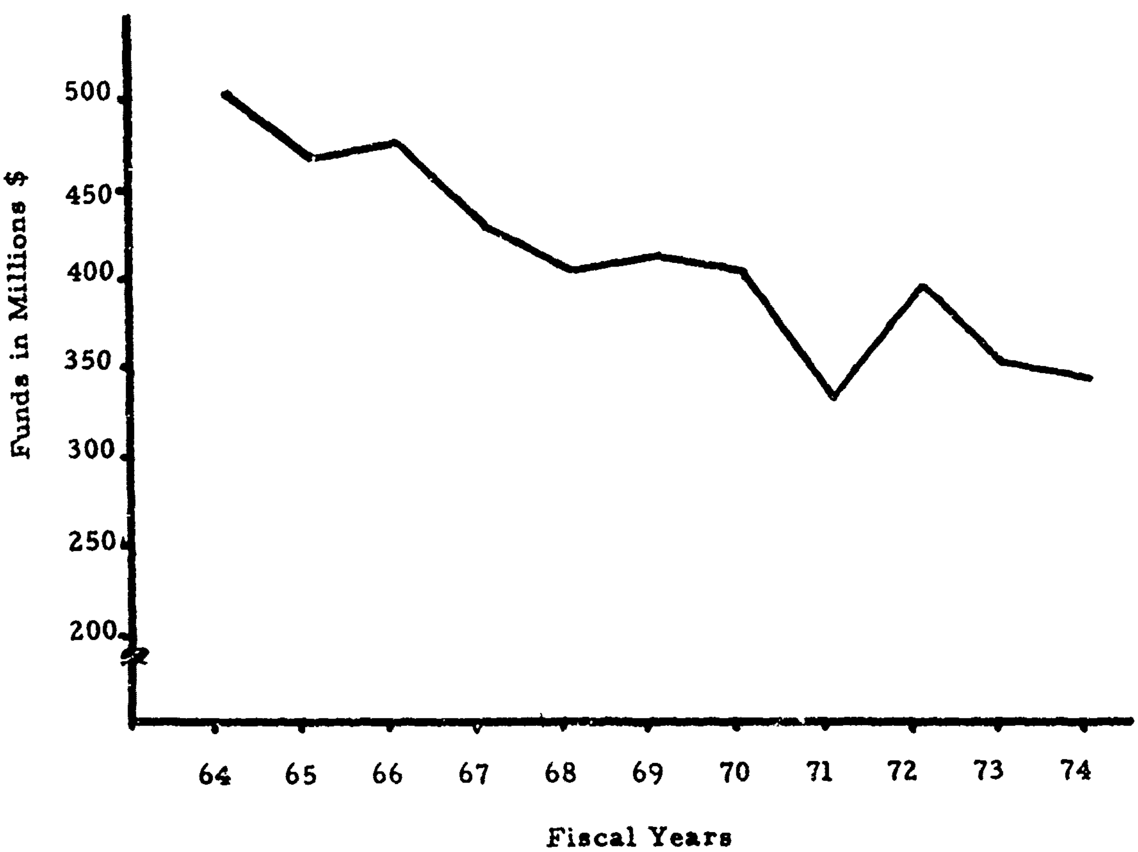
a very constructive departure from the past practices of structuring rather complex development models much later in the cycle.

10. Manufacturing Methods and Technology (MM&T): At numerous laboratories, the team encountered commendable examples of the application of MM&T effort which resulted in large procurement dollar savings. These examples varied from savings of a few cents on high-density items such as fuzes and munitions to large dollar savings on low-density items such as cannon tubes. The opportunities for achieving these economies were appreciably enhanced by the close professional interrelationship and geographical proximity of the R&D and production engineering teams.

11. Integrated "Affordability" Engineering Design: At the Night Vision Laboratory, the team witnessed an extraordinary engineering development approach to achieve commonality of a complex subsystem in order to secure cost reduction benefits of large-volume multi-application, tri-service production which would otherwise be cost-prohibitive. The importance of management's appreciation of the relationship of procurement and production with engineering design was dramatically demonstrated.

ANNEX B

FUNDING OF ARMY TECHNOLOGY BASE
(Constant '74 $)



ANNEX C

TEAM VISITS, BRIEFINGS, AND DISCUSSIONS
(excluding joint AMARC briefings)

Laboratories and Commodity Commands

Twenty out of 21 AMC laboratories and all arsenal and commodity command headquarters were visited.

MICOM Headquarters and Laboratories, Huntsville, AL	7-8 Jan 1974
Air Mobility R&D Laboratory (AVSCOM), Moffett Field, CA	9 Jan 1974
TACOM Headquarters and Laboratories, Detroit, MI	11 Jan 1974
ARMCOM Headquarters, Rock Island, IL	21 Jan 1974
Rock Island Arsenal (ARMCOM), Rock Island, IL	22 Jan 1974
Picatinny Arsenal (ARMCOM), Dover, NJ	23 Jan 1974
ECOM Headquarters and Laboratories (Avionics Laboratory, Combat Surveillance & Target Acquisition Laboratory, Communications ADP Laboratory, Electronic Warfare Laboratory, Electronics Technology & Devices Laboratory), Ft. Monmouth, NJ	24 Jan 1974
Frankford Arsenal (ARMCOM), Philadelphia, PA	30 Jan 1974
Edgewood Arsenal (ARMCOM), Edgewood, MD	31 Jan 1974
Ballistics Research Laboratory, Aberdeen, MD	31 Jan 1974
Human Engineering Laboratory, Aberdeen, MD	31 Jan 1974
Natick Laboratories (TROSCOM), Natick, MA	6 Feb 1974
Army Materials and Mechanics Research Center, Watertown, MA	6 Feb 1974

ANNEX C (cont'd)

Benet Laboratories (ARMCOM), Watervliet Arsenal, NY	7 Feb 1974
Mobility Equipment R&D Center (MERDC) (TROSCOM), Ft. Belvoir, VA	13 Feb 1974
Night Vision Laboratory (ECOM), Ft. Belvoir, VA	13 Feb 1974
Harry Diamond Laboratories, Washington, DC	15 Feb 1974
TROSCOM Headquarters, St. Louis, MO	26 Feb 1974
AVSCOM Headquarters, St. Louis, MO	26 Feb 1974

Department of Army and AMC Headquarters

AMC Headquarters meeting with Deputy for Laboratories, Deputy Commanding General for Materiel Acquisition, and Director of RD&E.	17 Jan 1974
OCRD, DA Headquarters, meeting with Chief of Research and Development, Deputy CRD, Director of Developments, Director of Plans and Programs, and Deputy ASA(R&D).	17 Jan 1974
DCSPER, DA Headquarters, meeting with Chief, Civilian Personnel Training and Career Management Division (AMC Chief of Civilian Personnel was also represented).	8 Feb 1974

CHAPTER VII
DIRECTORATE REPORT

A. I[illegible]DUCTION.

1. [illegible]ference [illegible] to the illustration on Page II-1 which depicts the AM[illegible] appro[illegible] three team efforts collectively bracketing all phases of the [illegible] materiel acquisition process and three team efforts that deal with three functional areas of the process. These latter are depicted in the illustration as orthogonal to the phase-team searc[illegible]s. Such an approach would result in six team reports.

2. During the course of the work, the necessity for a seventh team report suggested itself:

a. Certain broad-banded issues (i.e., the DA Staff) would fall outside the assigned phases, even though the phase-teams themselves were broadly oriented as to scope of interest.

b. Certain important functional issues (i.e., personnel considerations) would fall outside the assigned functional purview.

c. Certain organizational issues that the six teams felt were endemic to Army culture and organization, and therefore, in a narrow interpretation of purview should be in a Directorate Report.

B. OVERALL CONSIDERATIONS.

1. Army Progress In The Materiel Acquisition Process.

a. Issue. Considered in terms of the several phases and many functions involved, what is the Army's progress in this relatively new-to-the Army process?

b. Discussion.

(1) The Army has had in its history an undue number of materiel acquisition failures. Some of these repeat themselves over large quanta of time. We have sought a common and perhaps correlating phenomenon in this seemingly loosely coupled historical phenomenon.

(2) The causative that we would indict most strongly would be the vocational culture of the Army. We would quickly move to defend this service for the basis for this very culture, - personal leadership, the idea that people, well trained and disciplined people, win wars as contrasted with large masses of equipment; and the reliance on the realities of command in a battlefront situation. However, this "tight" culture has intersected negatively any free-wheeling, truly imaginative, and flexibly controlled approach to new weapon inventions and even new weapon development.

(3) Having said all this, AMARC must quickly endorse the Army response to DOD 5000.1. The Army has sincerely and rapidly fleshed out the DOD intent with its own array of documentation and procedures. Elsewhere in this report (i.e., Testing) there are some suggestions for a rewrite of AR 1000.1. Aside from this particularization we would allege that the Army documentation is in good response to the DOD intent.

(4) The Army is cognizant of (and has even documented at length) its historic failures. It has analyzed these with considerable objectivity. It has a collective view that -- outnumbered and outgunned by the Russians -- its major recourse is to search out more imaginative and more cost effective weaponry. It is trying to achieve such an objective.

(5) The Army has taken to the ASARC/DSARC approach to life with enthusiasm. This approach has procedural vigor, is self-consistently organized, and provides a basic channel of communication. By and large the Army likes it, and their enthusiasm may have impacted the quality of the data and decisions that this service brings to the process. Some pronouncements can be made: The pending Army Staff reorganization appears beneficial in our areas of interest.

(6) Within AMC, the Commodity Commands tend to emphasize replenishing old weapons and components, and are highly competent in this emphasis. The Army asks itself repeatedly, - how can we improve in materiel acquisition? In contrast to performance of the 1955-65 period, much improvement is evident in the Army.

Meanwhile, the problem gets significantly more difficult because of where the world is going, because of fixed charges, inflation, the American view of the Defense Establishment, etc.

(7) Originally AMARC zeroed in on AMC because most of the detail of materiel acquisition is wrapped up in this organization. AMC is large and, in some ways, monolithic. Because it is large and of a relatively narrow purpose it does its thing perhaps independently of the Army quartered in the Pentagon, where there is a broad diversity of chores.

(8) AMARC's post-review opinion would not single out AMC as the singular cause of bad equipment. Rather we would suggest that DA, as a whole, must sustain critical judgment for the inadequacies that remain, - uneven response; incomplete development of implementing procedure; lack of self-analysis; an institutional bias towards optimism and uneven acceptance of possible problem areas.

c. Recommendations.

(1) DOD and Congress should be apprised of the sincerity of the Army response to the need.

(2) After accommodating AMARC recommendations, allow the post 5000.1 DA overall process of materiel acquisition to mature.

(3) Insist on a methodology of self-evaluation in the process in question. (See page VII-11.)

2. How Should the Army Rank-Order (Priortize) the Effort.

a. Issue. Materiel acquisition may not get enough executive time in the Army.

b. Discussion.

(1) Historically the qualitative observation has maintained: - the Army is the most personnel-sensitive and the least equipment-sensitive of the three services. Notwithstanding, this service has responded to 5000.1 in a manner much the same as the other services.

(2) Has this response been even too strong? Probably not, if the Army has objectively viewed its history of acquisition. However, should not executive attention have properly been drawn to this issue sometime in the past? But what about the future? Consider a possible target Army priority listing:

(a) Combat readiness, materiel readiness, "fill-the bins".

(b) A continuous program to raise the pride of and in the Army.

(c) The All-Volunteer Army.

(d) Control of growth of the Army's "fixed charges".

(e) Drug abuse, race relations, equal employment opportunities.

(f) Where are the Russians going on the ground.

(g) How and how much to use battleground nukes.

(h) Response to the media, OSD and Congress.

(i) Whither the appendage commands, USARPAC, USARAL, etc.?

(j) The Army people problem, enormous needs vs DCSPER and the Civil Service.

(k) The Reserve Army, - its utility, readiness, political impact.

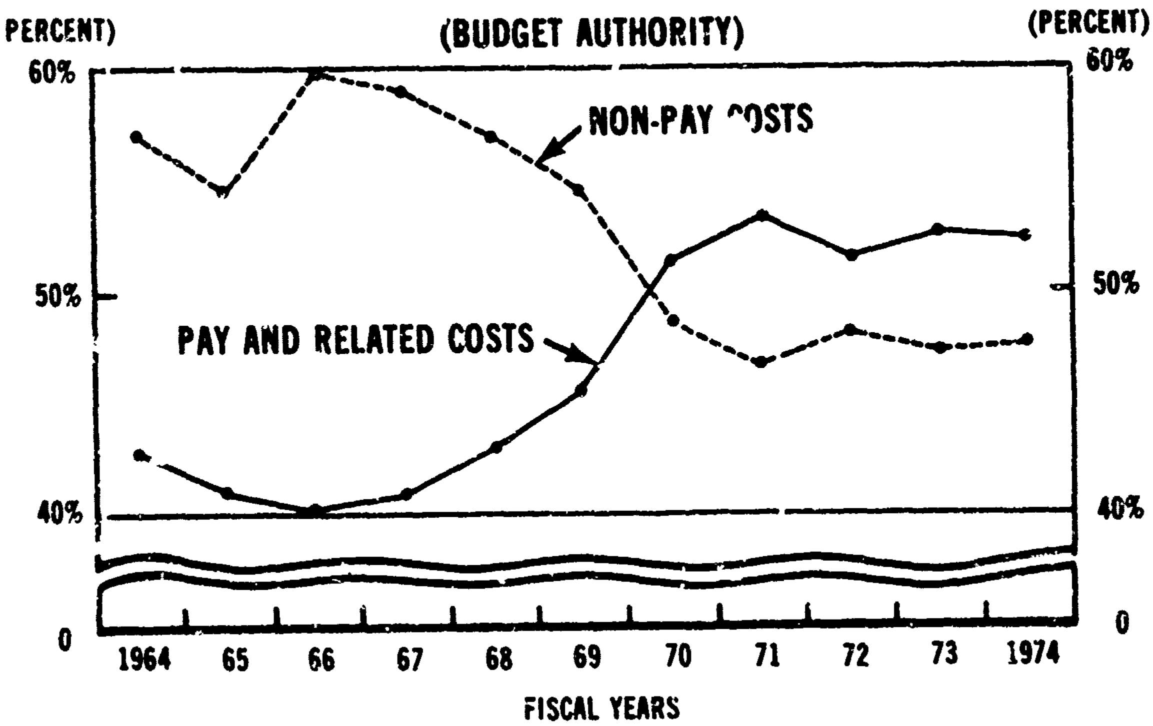
(l) How should the Army fight when the political ground rules do not permit victory (i.e., Korea, Vietnam ad infinitum).

(m) Materiel Acquisition, AMC, TRADOC and all that.

Fig VII-1 from the Annual Defense Department Report of FY 1974 depicts the DOD fixed charge problem.

FIGURE VII-1

PAY AND RELATED COSTS AND NON-PAY COSTS AS A PERCENT OF TOTAL DEFENSE BUDGET



(3) As the most people-sensitive service, the Army's fixed charge indices are higher than the other Services. Thus, the materiel acquisition funds are relatively smaller and the consequent

qualitative priority associated with the acquisition of equipment would appear to be less than in the other services. (The need may be higher than for the other services, however, in light of the Russian numerical superiority). If this be true then, there is an OSD problem because of the Pentagon's "fixed-budget" status).

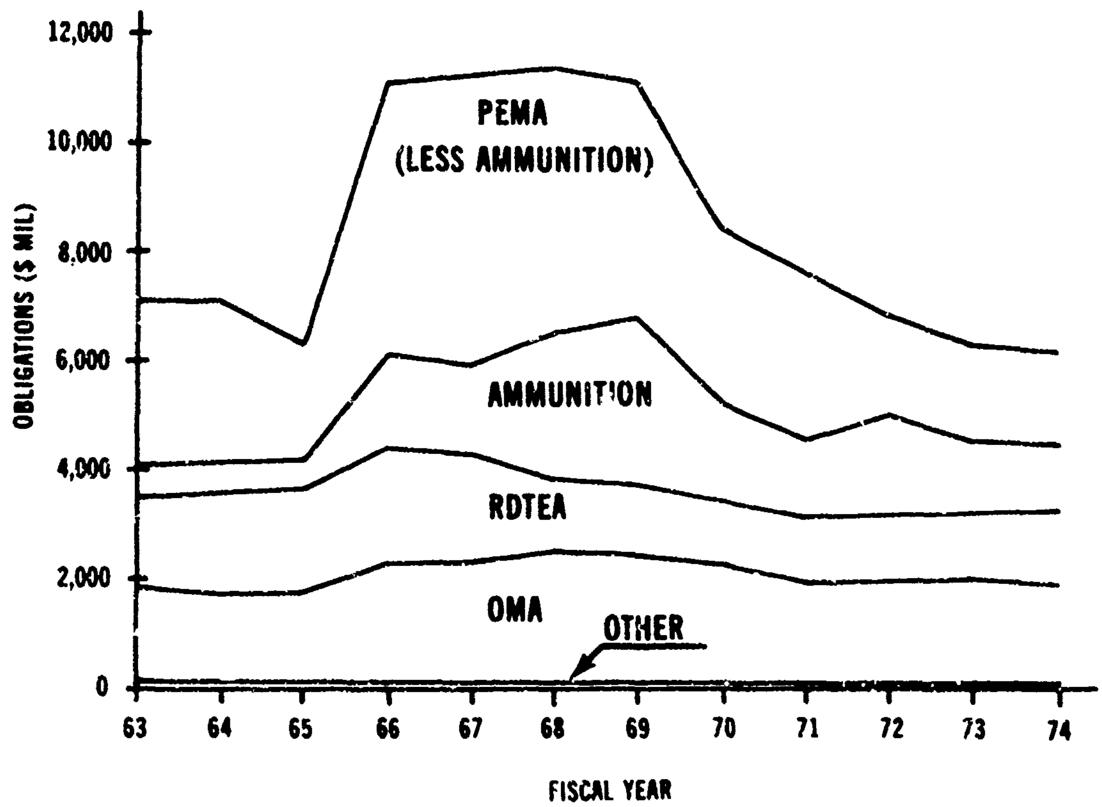
(4) Of the money that remains after fixed charges what percentages can be factored into

(a) Acquisition of "new" materiel and

(b) Reordering and upgrading of "old" materiel?

Fig VII-2 attempts to deal with this question.

FIGURE VII-2: ARMY MATERIEL COMMAND TOTAL OBLIGATIONS (1974 CONSTANT DOLLARS)



(5) A superficial overview of Fig VII-2 suggests that -- as far as the Army is concerned -- 1964 should have been the year that DOD 5000.1 came into being. New system PEMA for 75 ≅ 20% of PEMA.

(6) In industry, survival equates to sufficient cash flow, and growth equates to new markets, new products and increasing profits. A rough analogue can be drawn up such that RDTE and some PEMA can be used to size up the executive priority of materiel acquisition. Assuming an all-up 74 Army budget of approximately $22 billion, an accountant might suggest that the process should require 15 - 20% of the Army's executives time.

(7) However, the array of Army concerns depicted above contain elements that are not budget-dependent. Thus the 15-20 % could be on the high side.

(8) On the other hand, geopolitics can change rapidly and the long term viewpoint of the Army would suggest strongly that more time be devoted to the materiel acquisition process. This would tend to balance out the diminishment pressure of the previous paragraph.

c. Recommendations. None.

3. Simple Weapons Versus Complex Weapons.

a. Issue. The Army should be acquiring a bias towards austere, low cost weapons. It is not doing so.

b. Discussion.

(1) The Pentagon's approach to military materiel acquisition has developed from an economy of abundance. Such an economy no longer exists. Except for those fortunate individuals in this country who are unaffected by inflation, and aside from the economic judgments that inflation produces, Americans are opting for a simpler existence, a lower profile, a more austere living pattern, smaller and simpler autos, etc. The Army belongs to the American people.

(2) At the same time the Army's market place is relatively much smaller than it has been in the past. Table VII-1 depicts this situation. It represents a mandate, however correctly or incorrectly transmitted, from the American people.

(3) Israel, France and (the Army's potential adversary) Russia have a new weapon and design and procurement philosophy that centers on evolutionary development, a steady transfer of basic design elements from earlier to later weapons and a relatively strong, self enforced and superior-heirarchy reinforced constraints on the incorporation of high risk technology.

(4) Such a principle of evolutionary development accommodates the seduction of new technology and tends to block out abstractly attractive possibilities.

(5) Such a developmental philosophy has not been characteristic of US weapons in general, our philosophy having been nurtured in an economy of abundance. A complex weapon leads to a prolix development. Thus, the economic, development, and fielding control function itself becomes extremely sophisticated - a natural result is the necessity for DOD with its levels of reporting, reams of documentation, and required micro-detail.

(6) At the first level, i.e., the all-up configuration, this problem can more readily be met head-on. However, it is in the subsystem area that the national bias towards new and risky technology comes into sharp focus. This would contrast with, say, weapon progress evolving from a new configuration wrapped around proven and standard subsystems.

(7) Complexity means either user difficulty or large maintenance/logistics requirements, or both. If one equates DOD-designated mental ability levels I & II to the ability to interact with complex, high technology dependent equipment and levels III & IV to simple equipment the DOD data associating with the all-volunteer Army are probably as yet inconclusive as to what Volunteer Army user ability the designer should assume.

TABLE VII-1: Changing Priorities

	FY 1964 to FY 1968	FY 1968 to FY 1974	FY 1964 to FY 1974
Change (current $ billions) in:			
Defense Spending	$+ 27.2	$+ 1.0	$+ 28.2
Other Federal Spending	+ 34.6	+ 93.5	+ 128.1
State and Local Spending	+ 33.1	+ 103.2	+ 136.3
Change (constant FY 1974 $ billions) in:			
Defense Spending	$+ 25.6	$- 34.4	$- 8.8
Other Federal Spending	+ 29.7	+ 50.0	+ 79.7
State and Local Spending	+ 28.0	+ 60.9	+ 88.9
Public Employment (000)			
Defense (includes military)	+1,114	-1,588	- 474
Other Federal	+ 230	- 1	+ 229
State and Local	+1,905	+2,365	+4,270
Total, Public Employment	+3,249	+ 776	+4,025
Total labor force (000)			
Defense a/	+2,007	- 2,877	- 870
All Other	+4,800	+12,587	+17,387
Total Labor Force Change a/	+6,807	+ 9,710	+16,517

Defense spending as % of:

	GNP	Federal Budget	Net public Spending (Federal, State & Local)
FY 1950 (pre-Korea)	4.5%	26.8%	18.8%
FY 1953 (Korea Peak)	13.3%	60.3%	46.1%
FY 1964 (last peacetime year)	8.3%	41.8%	28.1%
FY 1968 (SEA peak)	9.4%	42.5%	29.2%
FY 1970	8.2%	38.4%	25.1%
FY 1971	7.5%	34.5%	22.2%
FY 1972	6.9%	31.7%	20.6%
FY 1973	6.2%	29.0%	18.9%
FY 1974	6.0%	28.4%	18.0%

a/ Includes military and Civil Service personnel and Defense-related employment in U.S. industry.

(8) To an extent, the tri-service rivalry in the DOD budget process can cause the proposing of complex and difficult-to-develop weapons in the hope that OSD (and Congress) can be nudged into a higher budget allocation if the imputed performance virtues of an expensive weapon catch on. On the other hand austerity in materiel acquisition can seem to lead to a reduced slice of the pie.

(9) Imputing complexity of weaponry to a rational institutional response to the type of management imposed by the executive and legislative branches doesn't solve the problem, particularly since the Army has proportionately less of its budget devoted to new weapons. Thus, it might well be the candidate to "break the daisy chain".

c. Recommendations.

(1) SECDEF should continue the practice of permitting self-generated force-trades to the Services to help towards establishing a bias towards simplicity. If it sees a value to this approach it must be prepared to deal with the Armed Services Committees on this basis.

(2) An institutional bias away from weapon complexity be instituted in the Army. High technology must be scrutinized in terms of the developmental risks it induces. Perhaps this is already underway. CSA must lead. The ASARC/DSARC process should reflect this bias, and should hammer at the issue. Some advocate capability (perhaps in TRADOC) should be structured to staff this role in the ASARC/DSARC discussions.

(3) TRADOC be tasked the chore of designing,

(a) an analysis/decision tree methodology for choosing -- in any given situation -- between fewer, complex weapons and more, simple weapons

(b) a graphics/communication package that permits in depth understanding of this trade-off. Page I-18 of the Requirements and Concepts section of this report discusses a first step in this direction.

4. <u>AMARC Implementation and The Continuing Upgrading of the Materiel Acquisition Process.</u>

a. <u>Issue.</u> AMARC goes away. What happens? Even without AMARC the Army has made many pertinent changes. Will these work? The process previous to the current Army reorganization was a relatively new one. How do the USA and the CSA obtain feedback and a close-in-continuum of improvement?

b. <u>Discussion.</u>

(1) It is understood that the section of OSD devoted to materiel acquisition will be phased out.

(2) A qualitative priority overview of the Army chore structure suggests that only a minority percentage of its executive time can be devoted to this activity on a day-to-day basis.

(3) Another Arab-Israeli bang can materialize and AMC preoccupation will return to "filling the bins", and to the Tech Data Package.

(4) The Army's current optimism re the All-Volunteer Army can disappear as more long-time data emerge.

(5) The Army Staff makes extensive use of a user surrogate.

(6) Why not an executive surrogate for the materiel acquisition process?

c. <u>Recommendations.</u>

(1) Army should replace AMARC with an ongoing review board.

(2) The review board should continue the design, flesh-out and updating of materiel acquisition as a process. It should not function to review any individual acquisition on a go-no-go basis.

(3) An ad hoc, one year expedient is suggested.

(4) CSA and USA should consider this board much as a subcommittee of an industrial board of directors; receive reports once-a-month and a one-year terminal report.

(5) Army should make the year-end report available to OSD.

(6) The Board should be chaired by the Director of the Army Staff - Membership should include (come from) AMC, DCSRDA, TRADOC, ASA (I&L and R&D), DCSOPS.

C. FUNCTIONAL CONSIDERATIONS.

1. The Enhancement of Professionalism In the Army.

a. Issue. Within the Army culture, professionalism connotes a professional soldier. This is centrally valid but an array of peripheral-to-soldiering professionals is necessary to the Army. The Army is not forcing and enhancing this latter type of professionalism with sufficient force and interest.

b. Discussion.

(1) This is a functional issue, probably best described as a "people" consideration. To the extent that the issue is a valid and deep one, it phenomenologically relates to the materiel acquisition process. It crops up elsewhere in this AMARC report as to:

(a) Program Managers (See attachment, LMI Document)

(b) Cost estimators

(c) Laboratory Directors

(2) Actually the roster of discipline-specialists necessary to the Army to effectively acquire materiel is quite wide, - lawyers, purchasing agents, psychologists, educators, mathematicians, computer programmers, chemists, industrial engineers, etc etc.

(3) The situation is much the same in industry. The line of command runs through the managers, i.e., department managers, division managers, group managers, executive vice presidents, chief executive officers. Although industry tends to short-time hire many specialists such as architects, it also has a high density of professionals on the payroll. These people in industry are frequently more loyal to their profession than to their company, yet many, many companies continue to:

(a) Strive to hire the best

(b) Upgrade, train and educate the ones they have

(c) Provide for vocational leverage and enhancement

(d) Make sure that their vocational input has the proper leverage in corporate decision making.

(e) Build up their professional pride.

A similar picture obtains in academia (i.e., the colleges) as to accountants, lawyers, programmers, cost-effectivity analysts, cash flow specialists. Academia truly does reward increases in professional stature of its non-teaching staff with increased status, job benefits, sabbaticals, etc.

c. Recommendations.

(1) Continue and expand the Army emphasis on a program of professional ability and pride enhancement for the narrow-discipline specialists that abound in the organization. Specialists can be either Civil Service or in uniform.

(2) The suggested program should involve seminars, meetings, courses, degrees, sabbaticals, training in industry, and rewards.

(3) In the Army program the awards and rewards for professional achievement should be structured so as to be attributable to the Army.

(4) Publish DA Pamphlet 600-3 Officer Professional Development and Utilization. Publish it now. It is presently in Draft.

(5) Selection Boards for Professionals sh[illegible] have a corresponding specialist on board. Selection Board members should be made to study a tailored information digest on the job in question. PM Selection Boards for major programs should be at the DA level, - for minor programs at appropriate levels within the AMC.

2. <u>Larger Use of the Task Force Results.</u>

a. <u>Issue.</u> The assembly and operation of a Task Force represents an extraordinary commitment of (human) assets. It is well worth this effort. In fact, more use can be made of it.

b. <u>Discussion.</u>

(1) The task force process goes on in much the same manner as a massive industry proposal effort. Some differences are to be noted:

(a) The Army does not maintain a permanent task force nucleus.

(b) Task Force is much smaller than we would expect, - 20 to 40 people.

(c) Task Force participants do not include members of rank higher than the Task Force Director, whereas the industry TF Leader can and does commandeer the General Manager to structure the assets-available section, the VP-Controller to do the costing, the Chief Financial Officer to do the profit rationalization, etc etc.

(d) The consultant, the outside specialist, and members from sister services do not participate in the effort.

(e) Experiments are not made a part of the effort.

(f) Speci[illegible] to-the-program computer applications are not generated and utilized.

(g) Detail design : d extensive configuration design is not accomplished but a bevy of contractor reports and proposals are available.

(2) Continuing within the context of an Army-Industry comparison of the ad hoc Task Force Effort, industry might be proud of the DCP and its supporting reports, but would not be proud of the final report for the following reasons:

(a) Validating experiment is everywhere absent

(b) Citations and references are skimpy

(c) No special, keenly appropriate computer application

(d) Technical content approaches the aspect of window dressing

(e) The Development Plan is relatively thin, mile-stoning is not thorough, the graphics and communication are relatively uninstructi e

(f) The latter half of tl e program, - testing, training, associated ground equipment, production methodology, tooling economics, is not even completely present in outline

(3) What does the Army seek from a Task Force approach. Well, how about,

(a) Urgency?

(b) The inducing of a decision?

(c) A reasonable validation of technical and operational feasibility?

(d) A ROC generator?

(e) A plausible Development Plan?

AMARC would say that the process is productive of just these desiderata.

(4) What additional contributions might the Army desire out of a Task Force Approach? Well, how about,

(a) A foundation for a particular weapon acquisition strategy?

(b) A womb-to-tomb detailed preview of the program?

(c) Rigor as to producibility, manufacturing process choice, lot sizing versus tool economics, etc?

(d) An explicit evaluation of special training requirements, life cycle costing, critical commodity effects, etc?

(e) An hypothesis of how the weapon in question will change future tactics?

(f) A plan for "market testing"?

c. Recommendations.

(1) TRADOC establish a "Task Force Factory" as suggested in the foregoing text and incorporating a permanent nucleus. It need not be and probably should not be in the Pentagon. The several competences of SAFSEA could contribute to this objective.

(2) The rear-end of the output should be extensively upgraded, responsive to the questions immediately above.

(3) A weapon system acquisition strategy be added to the assignment.

D. ORGANIZATIONAL CONSIDERATIONS.

1. Rigor in Requirements Generation.

a. Issue. Even when timely Required Operational Capabilities (ROCs) are generated, they are not well thought out.

b. Discussion.

(1) The ideas that lead to a bona-fide requirement have to be played with, analyzed and experimented with both broadly and in depth. TRADOC has not had a resource capability to experiment with ideas before requirements are generated.

(2) What should be the nature of such a resource?

(a) It should certainly be analytic, i.e., the equations of motion, the mathematics of guidance, ballistic tables, damage statistics, the aerodynamic laws, etc. are all subject to useful and ROC-pertinent analysis, synthesis and judgmental interpretation.

(b) It should probably be mechanistic (computer-cued), i.e., prestructured programs should be available and particular ROC-oriented programs should be generated.

(c) The inclusion of an experimental and evaluation capability appears indicated. One critical and pointedly designed experiment can be worth a roomful of computer tapes or a Pentagon full of Commanders' opinions.

(d) It should be cost-intensive and otherwise statistically embedded as to performance-index values, cost-effectivity, developmental risks.

(e) It should be operationally extrapolative, i.e., future threat evaluation, force planning, future tactical concepts, the probabilities of future geopolitical constraints must on a pre-ROC basis be made available and endemic to the rigorous approach to a formal requirement.

c. Recommendations.

(1) Transfer SAFSEA analytical capability to TRADOC.

(2) Consider transferring the Materiel Planning Directorate from AVCSA to DCSRDA and set up forcing functions to have MPD strongly intersect the pre-requirement developmental activity as a requirements oriented systems analysis and review capability.

2. Redundant and Diffuse Management of the Early Development Process.

a. Issue. The Army has a research and development capability distributed among its several laboratories and, to a second order, under contract. A prime purpose of this capability is the generation of new weapons and equipment to eliminate mission deficiencies and to operationally equip the soldier. The Army's R&D capability is oversupervised and red-taped in a manner antithetical to its purpose of generating spontaneous, fresh, original ideas.

b. Discussion.

(1) The situation is roughly like a charity project wherein the administration of the charity team costs as much or more as the total of donations.

(2) In searching for common phenomena underlying a history of unsuccessful weapons development, the need for freshness and viability of the Army's development capability early in the development cycle was an across-the-board discernment of AMARC.

(3) Consider the plight of the R&D types working on technical efforts that can lead to the elimination of a mission deficiency. Such a possibility elicits (authoritative) interest all the way up the line.

(a) The lab director

(b) Director, RD&E, and other staff elements, commodity command

(c) The Commodity Command Commander

(d) The AMC Chief Scientist

(e) The Deputy CG, AMC for Materiel Acquisition

(f) The AMC Deputy for Labs

(g) The AMC Staff, Director of RD&E, AMC Comptroller, Director of R&D

(h) CG, AMC

(i) The Army RD&E Staff; CRD, ACSFOR, Army Chief Scientist

(j) DCSLOG; AVCSA; MPD, OCSA; COA

(k) VCSA, CSA

(l) The ASA(R&D), ASA(I&L), ASA(FM), DUSA(OR)

(m) USofA, SA

(n) DDR&E, ASD(I&L), ASD(PA&E), ASD(C)

(o) DEPSECDEF, SECDEF

(p) Individual OSD'ers pulsing the system

(4) The Army uses the Annual Budget exercise as a method of control. The "layers" outlined in the previous paragraph are, therefore, the R&D budget check points in the upward flow of approval and coordination. It should be noted that the several Chief Scientists involved are staff to their respective CG's, and are used for trouble shooting, etc. CRD's Chief Scientist is slated to get back in the chain of command (July 1, 1974?). There is not noted in (a) through (p), above, the inputs of TECOM (developmental testing), ARO and Durham (contract research) and TRADOC (R&D for requirements determination) nor is the R&D Board assembled by CRD delineated. This latter has a real effect on what R&D is accomplished by the Army. The impact of the AMC Staff is difficult to depict as it intersects the R&D budget. It has been described as an "incredible number of little offices to touch base with".

(5) A natural question asks itself, - why the layering in DA Staff in the R&D domain? Is CRD really necessary? Should not the CRD be part of the ASA/R&D? Or taken another way should not

ASA(R&D) be coadjoint with Army Staff? Additionally, an industrial approach might go as follows: Combine their Army research leadership functions under a single individual reporting to the ASA(R&D). Give him one Deputy for each major clinical discipline. Assign to him the Program Planning and core funding responsibility for the structure of Army Labs (Development Centers?). Such an approach could lead to a zero-time, wide-channel of direct communication between ASA(R&D) and AMC.

c. Recommendations.

(1) The ASA(R&D) should draw up an authority and responsibility policy document that spells out responsibilities and thresholds of R&D activity all the way up the ladder, including OSD. A number of the considerations of the "Discussion" just above should enter into the study that should precede the drawing up of the document.

(2) As noted elsewhere in this report, Army should use single element funding for each lab for its self-determinative (6.1 through 6.3) funding.

(3) Army/AMC should encourage the labs to amplify and extend their "marketing" activity. Labs can purvey their capabilities more extensively to

Subordinate Commands

PMs

Sister Services

Department of Transportation

Etc.

(4) Lab Directors should be accorded reprogramming authority for self-determinative R&D funds.

3. The Green Suit Syndrome Vs Lab Management.

a. Issue. Research leadership in other large organizations is assigned to professional researchers who have gravitated to management. With them research management is an end in itself, i.e., a career. In the Army, the labs are most frequently run by green suiters who come and go.

b. Discussion.

(1) This is really a sub-issue of the way the Army serves its professionals other than its professional soldiers. It is a sub-issue, however, which intersects the quality of new ideas generated for the Army. It is one, further, that the S&T Team did not elect to highlight.

(2) Research management has come to be a profession of itself. Frequently research managers continue to produce in their specialties, albeit on a reduced-time basis. Therefore, their leadership and direction of other researchers is enhanced. Moreover, they have a particular insight -- experience generated not learned second-hand -- as to methodology; the exchange between analysis and experiment; the effective utilization of laboratory equipment; the particular areas for skills upgrading; what the rest of the research world is doing; the physics of measurement, etc etc. Generally they read Science, The Scientific American and specialized journals as contrasted with, say the Army Magazine, Ordnance Journal, The Infantry Journal, Armor, etc.

(3) The leadership of many of the labs at the working level is military in charge. The labs are most frequently "commanded" by a Commander, and generally have a Technical Director who is a civilian and a professional researcher. It has been said that the relation between the two varies with each new Commander.

(4) Note that to achieve the equivalent of a lab directorship at IDA, one must sustain a rigorous exam by the staff. In order to become a Department Head at a University, a peer review is necessary. This peer review examines the applicant's research capabilities. And so it goes.

(5) It usually takes a new Commanding Officer a considerable time (6 mos, plus?) to learn the job. His tour is limited. Thus, in addition to the lack of real leadership of research, and to the inefficiency of the number of relearning cycles there tends, naturally, to be an impropriety in values. Almost by definition the lab commander's perspectives are short term. After his learning cycle he has to "make-his mark" in what time remains during his tour of duty. His emphasis is thus on short-term items, those which can at least begin to show results during his tour. This involves also the assignment of the best people to the short-lived projects.

(6) An advanced degree, per se, does not qualify one to perform in a professional function, particularly if the other professionals are thereby to be led in their daily chores. Some early practice of the profession is necessary. The assertion as made here that if an individual has not "grown up" in a laboratory, his background in supervising a lab is, by definition, superficial. Note, in passing, that the Army will not assign command of a brigade to a professional research physisist who might have read Clausewitz extensively as a hobby.

c. Recommendations.

(1) AR 70-55 permits R&D labs to have Civilian Directors. The Army should implement it more extensively.

(2) The Civilian Director should have an education-qualified military man as his Deputy, such deputization to be of the staff as opposed to the line type of functioning.

(3) The Military Deputy should be charged with keeping the user, TRADOC, etc. up to date on the progress of programs, on the training needs that might go along with new equipment. Also he can assist in the "marketing" of the lab.

4. The Big Programs Versus the Smaller Programs.

a. Issue. Big programs involve large sophisticated contractors, savvy and forceful PMs and frequent reviews. Small programs get by and large an administrative and purchasing agent treatment.

b. Discussion.

(1) A large proportion of Army materiel acquisition dollars go towards the procurement of small systems with low unit costs. Almost every member of AMARC has had multiple experiences in the kind of acquisition activity wherein the procurement does not receive adequate technical attention by the Army.

(2) Most of these small system procurements go to medium or small size contractors who nevertheless have a relatively high technical competence and a continuing desire to improve the product. This desire will resonate when bounced off an engineer, but will lead to contractor frustration and Army administrative irritation when the Army cannot or does not provide a product-interested point of contact.

(3) Admittedly this is a tri-service problem and not peculiar to the Army. Because, however, the Army appears to have taken the initiative in reviewing and revising its materiel acquisition process, it might be appropriate for this service to take particular initiative in this area.

(4) Admittedly also the number of such projects and the corresponding number of contracts can be very large. Thus the problem is akin to one in dynamics, involving large mass, small time constants and small forcing functions.

c. Recommendations.

(1) AMC should consider a small-program (technical) Ombudsman approach, with the Ombudsmen attached to headquarters.

(2) A corresponding care-and-feeding of small contractors program appears worth initiating:

(a) Periodic questionnaires - i.e., what's wrong with our procurement? how would you improve the product? when did you last talk with an AMC engineer? what do you find onerous in your contract?

(b) Local seminars.

5. <u>The Effect of OSD on the Process.</u>

a. <u>Issue.</u> Vis-a-vis the Army, how to optimize the leadership function given by OSD at the same time assure that OSD maintain the amount of control necessary to discharge its responsibilities.

b. <u>Discussion.</u>

(1) The Army is profoundly affected by OSD leadership and behavior. From the day he is a lieutenant the typical Army officer learns to interpret and accord with duly invested higher authority.

(2) Professor Reis (The Management of Defense, John Hopkins Press, 1964) has carefully researched the adversary system between the Services and OSD, the growth in DOD at the top, and the variously changing relations with Congress and its relevant committees. DOD has "won," and a true adversary system is no longer possible.

(3) DOD has recruited extensively from the R&D communities from the think tanks, and from academia. Such individuals are frequently questioning, analytical, curious, speculative and capable of producing their own detail.

(4) A general officer is a trained generalist, increasingly dependent upon his staff for detail.

(5) The now long drawn out encounter between the two cultures has been detrimental to the Army process of materiel acquisition from a strong but indirect cause. In order to be prepared for any question (and DOD has been very capable of asking shrewd questions) DA has relied on its staff for answers. For this, and other reasons, the DA Staff appears to have proliferated beyond all (industry-oriented) reason. The DA Staff appears well motivated, despite its myriad fractionation and multiple layering, and is, therefore self-compelled to interdict the materiel acquisition process at all levels and at some length.

(6) Individuals within DOD, curious, technically knowledgeable and forcefully intellectual occasionally-to-frequently intersect the Army development efforts. Authority motivated Army people seek an instruction in each question, etc.

(7) Elsewhere in this report is mentioned the tri-service budget "game" wherein each of the three services attempts to enlarge its share of the budget by bringing forth imaginative proposals. Much AMARC discussion centered upon Pershing as an appropriate Army development, Safeguard, ditto.

(8) Many of the AMARC team feel that the Army can exert more leadership in exact ratio to the amount of DA Staff that can be reduced. We observe that at the beginning of every war the staff is reduced. We wonder is the same (now) not true for DOD.

(9) One looks at ASD(I&L)[1] responsibilities and organization (Sept. 30, 1972) and then attempts to generalize this to nine or ten ASD's & DDR&E in DOD. The resulting number of directorates that overlap the Service functions by this process of generalized logic becomes very large. This is one of the layers often referred to. Such directorates tend to be reproduced somewhere in each of the Services, - thus another layer.

c. Recommendations.

(1) Note again the Requirements & Concepts ideas re OSD.

(2) An objective study should be attempted (perhaps under contract) to determine impact of DOD organization on materiel acquisition process of the three Services.

(3) OSD is now hydra-headed. Questions pour out of these many heads. The questions can overlap, or deal with the same issues. They appear not to be coordinated at OSD level. The result is tri-service organizational entropy ("an amount of energy in a system not available for doing work") gain. OSD should consider the establishment of a Deputy Secretary of Defense Management of Resources, for such coordination and leadership and for other useful functions as per Blue Ribbon Report.

[1] The only function-explicated section of DOD that information search could find.

ANNEX VII-A
AMARC DIRECTORATE VISITS, BRIEFINGS AND INTERVIEWS

A. <u>DEPARTMENT OF DEFENSE.</u>

1. Secretary of Defense.

2. Deputy Secretary of Defense.

3. Director of Defense Research and Engineering (DDR&E).

4. Principal Deputy Director of Defense Research and Engineering.

5. Deputy Director of Defense Research and Engineering (Acquisition Management).

6. Deputy Director of Defense Research and Engineering (Test and Evaluation).

7. Assistant Secretary of Defense (Installations and Logistics).

8. Assistant Secretary of Defense (Manpower and Reserve Affairs).

9. Assistant Secretary of Defense (Program Analysis and Evaluation).

10. Chief of Naval Material and other personnel in acquisition management positions.

11. Director of Development and Acquisition, Office, Deputy Chief of Staff Research and Development, U. S. Air Force, and other personnel in acquisition management positions.

12. Commandant, Defense Systems Management School.

B. OTHER GOVERNMENT AGENCIES.

1. Assistant Director, Division of Military Application, U. S. Atomic Energy Commission.

2. Assistant Comptroller General of the United States and other personnel from the GAO.

3. Assistant Associate Administrator for Organization and Management, National Aeronautics and Space Administration.

4. Mr. Robert Howard and other personnel, Office of Management and Budget.

C. DEPARTMENT OF THE ARMY.

1. Secretary of the Army.

2. Chief of Staff, Army.

3. Under Secretary of the Army.

4. Vice Chief of Staff, Army.

5. Assistant Secretary of the Army (Research and Development).

6. Assistant Secretary of the Army (Manpower and Reserve Affairs).

7. Assistant Secretary of the Army (Installations and Logistics).

8. Assistant Secretary of the Army (Financial Management).

9. Deputy Under Secretary of the Army (Operations Research).

10. Army General Counsel.

11. Assistant Vice Chief of Staff, Army.

12. Chief of Legislative Liaison, Army.

13. Deputy Chief of Staff for Military Operations.

14. Deputy Chief of Staff for Personnel.

15. Deputy Chief of Staff for Logistics.

16. Chief of Research and Development.

17. Assistant Chief of Staff for Force Development.

18. Comptroller of the Army.

19. Commanding General, U. S. Army Materiel Command and principal Deputies.

20. Commanding General, U. S. Army Training and Doctrine Command.

21. Commanding General, U. S. Army Forces Command.

22. Commandant, U. S. Army Command and General Staff College.

23. Commanding General, U. S. Army Operational Test and Evaluation Agency.

24. Commanding General, U. S. Army Concepts Analysis Agency.

25. Director, Planning and Programing Analysis, Office of the Chief of Staff.

26. Director, Materiel Programs, Office of the Chief of Staff.

27. Army Foreign Science and Technology Center Briefing Team.

28. U. S. Army Mobility Equipment Research and Development Center, Fort Belvoir, Virginia: Commander and staff.

29. Harry Diamond Laboratory, Washington, D. C.: Commander and staff.

30. U. S. Army Electronics Command, AMC, Fort Monmouth, N. J.: Director, Pershing II Task Force; Chief of Research and Development; three Project Managers.

31. U. S. Army Tank Automotive Command, AMC, Detroit, Michigan: Commanding General and staff; four Project Managers.

32. U. S. Army Test and Evaluation Command Headquarters, Aberdeen Proving Ground, Maryland: Commanding General and staff.

33. U. S. Army Combat Development Experimentation Command (CDEC), Fort Ord, California: Commanding General, CDEC; Deputy Commanding General, MASSTER.

34. U. S. Army Aviation Systems Command, AMC, St. Louis, Missouri: Commanding General and staff; four Project Managers.

35. U. S. Army Armaments Command, AMC, Rock Island, Illinois: Commanding General; Commanding Officer, Rock Island Arsenal, and staff.

36. U. S. Army Infantry Center, Fort Benning, Georgia: Commanding General, Deputy Commanding General, and staff.

D. MISCELLANEOUS.

1. LTG C. A. Corcoran (USA, Ret).

2. General F. S. Besson, Jr. (USA, Ret).

ANNEX VII-B

STUDIES IN SUPPORT OF THE AMARC--

THE PROJECT MANAGER

Task 74-14

March 1974

Prepared pursuant to Department of Defense Contract No. SD-321. Views or conclusions contained in this document should not be interpreted as representing official opinion or policy of the Department of Defense. Except for use for Government purposes, permission to quote from or reproduce portions of this document must be obtained from the Logistics Management Institute.

LOGISTICS MANAGEMENT INSTITUTE
4701 Sangamore Road
Washington, D. C. 20016

I. INTRODUCTION

Task Order 74-14, a copy of which is included as Appendix I, requested LMI to undertake certain studies in support of the Army Materiel Acquisition Review Committee (AMARC) examination of the effectiveness of policies and procedures bearing on the Army's total materiel acquisition process. The studies to be performed by LMI were specifically to address two subjects relating to the acquisition of major systems: effectiveness analyses and related statements of requirements; and the selection, training, and similar issues concerning project managers.

This report, which is addressed to the Development Committee of AMARC, is our report on the project manager. Section II deals with the project manager directly, and our recommendations for further action are found in Part D. Section III deals briefly with a few issues concerning project management concepts and the project management office.

II. THE PROJECT MANAGER

A. EXPERIENCE CRITERIA

Any discussion relating to the project manager is confronted by the fact that there is no unanimity concerning essential personal attributes or background and experience required for success as a project manager. Success and failure seem not to be related to any set of specifications and, lacking these specifications, there is a large commingling of personal views, strongly held but not provable to those who hold equally strong but opposite views.

It is therefore appropriate to acknowledge at the beginning that no set of experience criteria should be considered mandatory. The selection of specific officers as project managers should not be bounded by any set of mandatory criteria that limits the discretion of higher authority. Nevertheless, there is an emerging consensus on desirable criteria; that is to say, criteria thought likely to be conducive to a capability to manage complex acquisition undertakings in the environment of a military service:

- An undergraduate degree in a technical field.
- An advanced technical degree.

- Business management training reflected in the MBA degree or in comparable training in systems management.

- Attendance at the 20-week course in program management of the Defense Systems Management School (DSMS).

- On-the-job training in a subordinate capacity in a project management office for a total of five to six years.

- Operational experience--and, especially, recent operational experience--affording an understanding of user requirements and application of similar equipment in the field.

B. CAREER IMPLICATIONS

The major implication of the desirable experience criteria just described is that a career with those characteristics is not compatible with a career in the operational aspects of the service. The formal educational requirements of an advanced technical degree, the MBA, and attendance at DSMS span a period of three to four years; in addition, there are approximately four years schooling in basic and advanced courses, Command and General Staff Level College, and Senior Service College. A total of some eight years of schooling, plus five years in a project office, leaves a balance of only eight years for operational assignments leading to promotion

to Colonel in the twenty-second year of a military career. Eight years of operational and staff assignments is not sufficient to obtain equality of promotional opportunity with officers who have devoted their careers to operations. Although some few personnel officers will talk in terms of the desirability of officers being qualified in both arenas--in the operational side of the service and in systems management--they will admit in candor that dual qualification is in fact visionary.

The further implication of the experience criteria and the incompatibility of those criteria with an operational career is that the service must attract interested officers into systems management. This can be done only if that career program is competitive with the promotional opportunities available to similarly qualified officers in operational careers. If the experience criteria are accepted as a reasonable objective for project management training, a long-term commitment must be made by the service. An officer electing project management as a career would be embarking on a nine-year program of specialized schooling and assignments with essentially single-career objectives.

A related problem arises out of the limited number of project manager positions--presently numbering thirty-seven. The objective of obtaining tenured tours lasting three to four years results in an annual requirement for project managers numbering only ten to twelve. This problem is further complicated by the fact that project management itself is not a singular set of skills. Projects span a spectrum ranging from validation-development to production-deployment. The desired experience in the early project phases would draw heavily on research and development expertise--an expertise not needed (and even not suited) in the later project phases. As a consequence, the development of a career program in project management presents the service with unusual problems of developing special skills for only a few positions.

The central issue then is the manner in which the service comes to deal with the problem of attracting officers into a career program which develops a pool of experienced talent from which project managers may be selected. In this context, it is as easy to emphasize the problems of career development as it is to emphasize the need for sophisticated management of major

systems acquisitions. The attitude of the service toward project management as a career becomes a critical factor. Unfortunately, many Army officers still do not seem to have grasped the essential role which project management plays in accomplishing the total responsibilities of that Service. There is a certain negativism in dealing with project management--a negativism most obviously demonstrated by the fact that the first steps in developing a career program are only now appearing, although the need for action was identified in 1970.[1]

C. CURRENT STATUS

There are four basic criteria by which service achievement in project management may be measured. Tenure of the project manager is a measure of the stability of management. Previous experience in a project management office is a measure of the importance given to previous systems management experience. Although some people equate experience in related or similar activities, LMI believes there is no substitute for experience

---

[1] David Packard, "Policy Guidance on Major Weapon System Acquisition," Memorandum for Secretaries of the Military Departments, May 28, 1970. Blue Ribbon Defense Panel, "Report to the President and the Secretary of Defense on the Department of Defense," July 1970, pp. 79-81. AMC Regulation 614-3, published in July 1971 and revised in July 1972, is not considered pertinent because we could not find any evidence that it constituted an active or significant effort.

within a project management office. Promotion of project managers to General Officer is a measure of the importance attached to that effort by the Army. A formal career program for the development of project managers is also a measure of the importance attached to that effort.

1. Tenure. Tour lengths for Army project managers have been stabilized for a minimum of three years. An analysis by DCS Personnel showed the average tenure of project managers reassigned during the first six months of 1973 was 3.3 years. Adequate tenure is no problem today.

2. Previous Experience in a Project Management Office. Data provided to LMI indicate that only one of the nine Army General Officers presently assigned as project managers had prior experience in a project management office in any capacity. Only seven of the 28 Colonels presently assigned as project managers had prior experience in a project office in any capacity. In the combined group, eight of a total of 37 project managers (22 percent) had prior project office experience.

Data provided by the Navy and the Air Force show that a lower percentage of Army project managers has had prior

experience in a project management office than is found in the other services. This is especially true of General/Flag Officers: in the Navy, four of seven Flag officer project managers (57 percent) had prior experience in a project office; the comparable number for the Air Force was eight of nine General Officers.

It is evident from these data that the Army is deficient in ensuring that its project managers have adequate prior experience in systems acquisition management. This deficiency is most visible among General Officers assigned to project management.

3. Promotion to General Officer. Various statistics have been proferred by different organizations purporting to demonstrate either a higher proportion of Army managers has been promoted to General Officer or that they have obtained less than a fair share of promotions compared to others. The main element contributing to the confusion is the consideration given to Senior Service College attendance.

Attendance at a Senior Service College is essentially a mandatory criterion in the selection of all Army General Officers. If all Colonel project managers (a majority of whom has attended Senior Service College) are compared to all other Colonels (a

majority of whom has <u>not</u> been selected for Senior Service College), project managers will appear to have obtained unusually high recognition in promotion to Brigadier General. If, on the other hand, all Colonel project managers (many of whom have <u>not</u> attended a Senior Service College) are compared to only those Colonels who have attended Senior Service College, project managers will appear to have been slighted by promotion boards.[1]

4. <u>Project Management Career Program.</u> A significant advance in the career development of project managers in the Army will be made with the pending publication of DA Pamphlet 600-3, <u>Officer Professional Development and Utilization.</u> Chapter 30, entitled "Development of Project Managers," outlines a program to attract interested officers and to develop project managers by tailoring the education and assignment of officers who have chosen certain alternate specialties. This is described as "interspecialty development."

The decision not to make project management a specialty, but to build on other specialties, was a deliberate one. It reflected an assessment of both the limited requirement in numbers for project

---

[1]Attendance at a Senior Service College is now a "mandatory" criterion for Army project managers.

managers and the need to ensure a broad spectrum of experience and interest within the group of potential managers that was compatible with the broad spectrum of project characteristics. LMI endorses the approach taken by the Army for the reasons discussed earlier. At the same time, however, we note that Chapter 30 is deficient in three respects:

a. "Interspecialty development" connotes what is to us a sterile thought: that project management skills can be obtained by simply adding some special skill or knowledge obtained from one specialty to those obtained from another.

b. There is no requirement (or even a suggestion) that "interspecialty development" will be focused on weapon system acquisition as distinct from any other aspect of materiel management as, for example, inventory management.

c. There is no suggestion in the text (and only casual statement in the attached charts outlining hypothetical career paths) that prior experience in a project management office is desirable in the career development of a project manager

It is our understanding that following publication of Chapter 30 an organization will be established in MILPERCEN to monitor the development and implementation of the project management career program. Vigorous implementation will be essential in order to create a pool of qualified, experienced officers at the earliest practicable date.

D. PATTERNS FOR THE FUTURE

The elements of a strong program to develop project managers are already found in the Army structure. What remains, and what is essential, is to mount an aggressive program which is strongly supported by top-level managers within the Department. This part of our report is an effort to identify some major issues which must be addressed and to suggest appropriate responses.

1. Command and Command Equivalency

There has been a long debate over the question whether project manager positions--especially of major programs--should be designated command positions or should be formally recognized as positions equivalent to command. The importance of the issue lies in the perception that selection boards have favored those who have had command assignments--command thus appears to be a prerequisite to advancement.

The pending DA Pamphlet 600-3 describes command designated positions and clearly resolves the issue concerning project manager positions: these positions are not command positions.[1] DA Pamphlet 600-3 does not recognize any position as equivalent to command; therefore, project management is nowhere related to command in that basic personnel document. The concept of equivalency to command has been specifically rejected by General Abrams as a part of a long-term objective of deemphasizing the apparent importance of command:

> With regard to the command equivalency of project manager positions, I think this is a matter of semantics. Our present policy of equating certain positions to command is an attempt to recognize their level of responsibility and overall importance to the Army, but they are not really equivalent. What we need to do, and what we are doing under OPMS, is to stress the importance of different career patterns in accomplishing the Army's mission and to let each job stand on its own merit before selection boards. In the long run this should dispel the notion that command at each level is a prerequisite for advancement and overcome the need for artificially equating positions to command.[2]

---

[1] Chapter 7, "Command Selection System."

[2] Memorandum for Deputy Director of Defense Research and Engineering (Acquisition Management), 3 October 1973.

Whatever the merits of this objective in the long run, the mystique of command is a present and important factor in the Army culture. The pending DA Pamphlet 600-3 contains the following paragraph illustrating both the present importance and the continued influence of this mystique:

> The Challenge of Command. While there are numerous positions of high responsibility, other than command, in all specialties, it is nevertheless true that successful command is a hallmark of military professionalism. Thus command continues to be a much sought after and rewarding assignment.[1]

The perception of Army project managers of the action reflected in DA Pamphlet 600-3 is and must be affected by the steps taken by the Navy formally designating major projects (not all projects) as "equivalent to a Major Command."[2] Army policy, therefore, is seen to reflect an intent to downgrade the status of project management in the career development of an officer aspiring to General Officer rank.[3]

---

[1] Paragraph 7-8, Chapter 7.

[2] OPNAV Instruction 1211.8, 19 January 1972.

[3] Published instructions to Army General Officer selection boards provided to LMI do not address project management in specific terms. Letters of instruction to Colonel selection boards now simply list Project/Product manager assignments, with other positions, as "equivalent to command duty."

LMI believes that project management cannot obtain the status it needs to be given in the eyes of prospective managers unless major projects are formally recognized as equivalent to a major command. Therefore, we recommend that appropriate action be taken to remedy the present situation.

2. Board Selection

Board selection is an action which screens from among all eligible candidates those who are best qualified for the contemplated position.

It is an accepted procedure for filling important positions. The use of a board selection process is looked upon as a mark of the importance the service attaches to the position. The subject of board selection of project managers is related to the issue of command (or command equivalence), since boards are used now to select officers for command at the Colonel level. However, boards and command need not be inseparably related. A board selection process could be used to select or designate specially qualified officers for positions not described as command.

DA Pamphlet 600-3 does not provide for any board selection process for project managers because, we surmise,

project management is not treated as command. Here, also, the perception of Army project managers of the action reflected in that pamphlet is and must be affected by the Navy. Because major projects in the Navy are stated to be equivalent to a major command, the Command Selection Board selects ("designates" would be the better term) officers specially qualified for these positions.

As noted earlier, the selection of a project manager for a particular project is a special problem because each project is different: the basic commodity differs, and the different phases of a specific project call for different project management skills and background. In other activities, all positions are very much the same: the board can select among candidates those specially qualified and any of those selected can serve in any of the specific billets to be filled. Board selection does not necessarily imply that the board would select only the number of officers required to fill expected vacancies. It also does not necessarily imply that all vacancies must be filled by appointing only persons on the board list. The peculiar requirements of project management make it essential that the choice of a specific

project manager not be constrained. Board selection for project managers should be a method of designating specially qualified officers; the number designated should not be limited to the number of expected vacancies; and the appointing authority should not be constrained from appointing the "right man" who is not on the board list.

Board selection would contribute status to project management in the Army. In addition, it would provide a measure of the effectiveness of the management of a career program for project managers in the Army. While the appointing authority should not be constrained to the list of officers on the board list, it should be expected that normally he would appoint from that list. A significant number of appointments from outside the list would indicate that the career program was not developing a pool of officers that met the requirements of the Army.

The level and composition of the board is another subject that must be addressed. A HQDA board would have Army-wide status that would not be obtained by a board at a lower level; an AMC-level board would not have the

status. In addition, it does not appear appropriate to have the appointing authority also create the list from which he will normally select. At the same time, however, it is essential that the board have appropriate representation of officers experienced in weapon system acquisition to ensure selection of candidates with the requisite knowledge and skills. This representation should most likely come from AMC.

The Navy provides for board selection and command equivalence only for projects denoted as "major" projects. The Army might consider it appropriate to introduce a similar distinction among its projects.

3. Previous Experience in A Project Office

The single most important thrust in a career program for project management should be to ensure that project managers have had significant previous experience (some five to six years) at a subordinate level in a project office. Army implementation of DA Pamphlet 600-3 must remedy any suggestion that interspecialty development can be effectively obtained in an environment outside of project offices.

4. Education

The second most important thrust in a career program for project management should be to ensure that project managers have had the education appropriate to their career. The following steps are recommended to achieve this thrust in addition to postgraduate technical training:

a. ICAF should be made the preferred Senior Service College for officers in this career program.

b. The twenty-week course in Program Management at DSMS should be considered an essential assignment.

c. Army education programs in systems acquisition management should be strengthened. Only six weeks

of the 19-week course in Logistics Executive Development at the Army Logistics Management Center relate to systems or project management. In the absence of a strong internal program, the Army could rely on civilian schools or on the Air Force program at the Air Force Institute of Technology in Systems Management (15 months) or the Navy program at the Naval Postgraduate School in Systems Acquisition Management (18 months).

d. One or more courses in systems acquisition management should be added to the Military Academy program. There is nothing in that program now that would tend to create an interest in project management.

e. The Army program for training with industry could contribute significantly in education for project management.[1] This avenue for obtaining intimate knowledge of industrial organizations would seem a particularly interesting one to explore in view of the fact that the Army has so

[1] Pending DA Pamphlet 600-3, paragraph 3-20, Chapter 3.

few contract administration (plant representative)

offices compared to the other services.

5. Program Advocacy

In 1969, LMI noted that higher authority called upon project managers and their key subordinates for tasks which did not lie within their charter, knowledge, or expertise.

> Primary among such tasks mentioned was justification of the total program. Project managers believe that higher authority should present and defend the programs to OSD, BuBud, Congress, and the public. They believe that such activity is not a proper role of project people, who should be left to run the project.[1]

LMI has observed that project managers devote considerable time and effort preparing for and testifying at Congressional hearings pertaining to their programs.

We believe that it is appropriate to involve the project manager in such matters when the subject concerns the management, as opposed to the defense, of the program. It is our opinion that it is someone else's job to defend the program at higher levels of

---

[1] LMI Report, Project Management in the DoD--A Brief Survey, LMI Task 69-28A, July 1969, Washington, D. C., p. 34.

authority within the DOD and before Congressional committees. Project managers should be allowed to manage their programs. Their military and civilian superiors, we believe, should assume the role of program advocate.

6. Civilian Managers

Personnel resources in the nature of trained and experienced project managers will be limited for some years even if a career program is vigorously pursued at all levels of the Army. In the interim, the Army might examine the feasibility of utilizing civilian positions authorized under the provisions of 10 U.S.C. 1581--often referred to as Public Law 313 positions--to carry out research and development relating to the national defense that require the services of specially qualified scientists or professional personnel.

7. A Reassessment

The career program we have described is a program built on alternate specialties (especially the Research and Development specialty) which are designated between the fourth and the eighth year of service. This is the program described in DA Pamphlet 600-3. In Appendix II we have outlined a hypothetical career

progression embracing the education, project management office experiene, and operational experience deemed desirable for a career in project management. It is very clearly a crowded schedule. It may be too crowded a schedule. The program should be reexamined in a few years with a view to perhaps making the alternate specialties on which project management experience is built primary, basic entry specialties. This would provide additional time to develop specialty skills and experience at the expense, however, of some operational experience, and common experiences with other officers. While LMI is urging that project managers obtain specialized training and experience in management, we emphasize our conviction that a sound foundation in operational experience is no less important.

III. THE PROJECT MANAGEMENT OFFICE

A. INTERFACE WITH FUNCTIONAL ELEMENTS

Project management in the Army follows the matrix approach: a relatively small project office relies on the traditional functional organizations to perform its work. The matrix concept is an accepted, sound management approach; but it is one that requires special attention if project management is not to be robbed of its substance, maintaining only the form. It is a matter of relative emphasis--but that is a very important subject, and we believe that the Army puts too little emphasis on the project office and too much on maintaining unimpaired the capability of the functional organizations to perform their routine activities.

Project management is rooted in the concept that certain programs require special attention to their management, and to their allocation of resources, because they are the most critical--because they are more important than other programs or activities. Yet, we find people talking in terms that somehow project management should be fitted into the traditional system without adversely affecting the ability of the functional elements to perform their customary functions for all users. LMI believes

that effective project management will flourish only in an environment where senior management accepts the proposition that the functional elements must be hurt.

One example of the effect of philosophy on action can be seen in the initial staffing of project offices. It often takes a long time to establish and fill the civilian billets assigned to a new project office. A temporary solution could be obtained by collocation of personnel from the functional organizations--personnel who retain their billet in the functional organization, but who work in and for the project office until the billet assigned to the project office is filled. Collocation most assuredly reduces the capability of the functional element to support other activities: it becomes a question of relative priorities.

Acceptance of the fact that project management must hurt the functional organizations leads to considering the need to strengthen the capability of those organizations to support projects and other activities. Since project management implies a redistribution of resources--and not an augmentation of established resource levels--the route to strengthening the functional elements must lie in improved career development within those activities. If project

management is to succeed in a matrix approach, senior management must realize that projects put extraordinary demands on the talent of the functional staffs.

B. PROJECT OFFICE STAFFING

The staffing of a project office in a matrix approach is a nice question of judgment. There are no good guidelines. If that judgment is to err, it should err on the side of apparent overstaffing. A project needs an unspecifiable strength to perform some work within the project office in order to avoid becoming completely dependent on the largess of the functional elements. There needs to be a minimum capability to make up unanticipated failures to obtain expected support from functional organizations; otherwise, the project office is nothing more than a coordination and expediting activity. The matrix approach too often leads to understaffed project offices--partly a reflection of the tendency to favor the functional elements. Major projects need special attention in this regard.

C. CONTROL OF FUNDS

The one major strength the project should have is direct control over all funds for peoject-related work. Control of funds is often the only device which the project office has to obtain the attention

it needs and to exercise the control it seeks. All subsystem development undertakings which are a part of the system development should be funded through the project office, even those which are assigned to another Commodity Command. If the project manager is to be held responsible for the system as a whole, he should have control over its parts.

In emphasizing the need for central control over system funds, we would emphasize equally the need for direct funding of subsystem development undertakings which are independent of specified systems. Subsystem development should lead system development, and the funds for independent subsystem development should flow directly to the organization with the technical expertise.

ASSISTANT SECRETARY OF DEFENSE
WASHINGTON, D.C. 20301

Appendix I

INSTALLATIONS AND LOGISTICS

DATE: 17 January 1974

TASK ORDER SD-321-21
(Task 74-14)

1. Pursuant to Articles E-1 and E-3 of the Department of Defense Contract No. SD-321 with the Logistics Management Institute, the Institute is requested to undertake the following task:

A. TITLE: Studies in Support of the Army Materiel Acquisition Review Committee

B. SCOPE OF WORK: An Army Materiel Acquisition Review Committee has been organized to examine the effectiveness of Army policies and procedures bearing on the acquisition of major weapon systems. Specific aspects of the process will be examined by study teams constituted from various organizations. LMI will perform studies of selected problems in support of the larger study effort in the following areas of concern:

(1) Requirements and Concepts

Examine technical and operational effectiveness analyses and the statements of requirements for selected systems to ascertain their adequacy and responsiveness to decision-makers in authorizing development of weapon systems an in providing guidance in making trade-off analyses during development. If appropriate, recommend changes to achieve improvement in the effectiveness of analyses and statements of requirements.

(2) Development of Project Managers

Examine Army policy and practice in the identification, selection training, assignment, and role of Project Managers. Recommend changes in Army policies or implementation processes as appropriate to achieve the objectives of acquiring and utilizing highly qualified personnel as Project Managers.

2. REPORTS AND SCHEDULE: A memorandum report for each of the tasks above will be furnished four months after the acceptance of this Task. Informal briefings will be provided on current results on request.

G. I [signature]

Accepted: [signature]
Date: [illegible]

Appendix II

ARMY PROJECT MANAGER

Year	Phases of Development	Hypothetical Career Pattern: Proj.Mgt.Off.	Hypothetical Career Pattern: Operational	Hypothetical Career Pattern: Education	Year
30		Proj. Manager Major Project			30
29					29
28					28
27	Colonel				27
26					26
25		Proj. Manager Major Project			25
24					24
23					23
22					22
21					21
20	Lieutenant Colonel		Ops./Field*		20
19					19
18				ICAF	18
17		PMO			17
16					16
15					15
14	Major			DSMS	14
13			Ops./Field*		13
12					12
11				CGSC	11
10				MBA	10
9					9
8	Captain	PMO			8
7					7
6					6
5				Adv. Deg.	5
4				Adv. Crs.	4
3	Lieutenant		Primary Specialty		3
2					2
1				Basic Crs.	1

*Project Management Related Assignment

Assignments		Years
Operational		8
PMO		5½
Education:		
Basic	1	
Adv. Course	1	
CGSC	1	
ICAF	1	
Adv. Deg.	1½	
MBA	1½	
DSMS	½	7½
		21

APPENDIX A

LETTER OF INSTRUCTIONS TO AMARC DIRECTOR

APPENDIX A

DEPARTMENT OF THE ARMY
WASHINGTON, D.C. 20310

6 December 1973

MEMORANDUM FOR: DR. WENDELL B. SELL

SUBJECT: Army Materiel Acquisition Review Committee (AMARC)

Effective immediately, you are requested to assume the direction and leadership of the Army Materiel Acquisition Review Committee (AMARC) study requested by the Secretary of the Army. As such, you will have the responsibility and authority to conduct an independent review of the Army's total materiel acquisition process.

The enclosed instructions outline in general terms the scope, organization and objectives of this effort to the degree we have developed and agreed upon them to date. Per our prior discussion, you should feel free to suggest modifications to the steering group when and as they appear desirable to the task force. It is hoped that the results of this effort can be available in oral and written form for review by senior Army and other DOD management personnel by no later than 1 April 1974.

The importance and need for a hardhitting and objective review, analysis and critique of our existing materiel acquisition process cannot be overemphasized. It is earnestly desired that the study "tell it like it is" by summarizing and highlighting our strengths as well as our weaknesses together with relatively detailed recommendations as to how the latter can be materially improved in the near future.

Fred C. Weyand
General, United States Army
Vice Chief of Staff

Herm Staudt
Herman R. Staudt
Under Secretary of the Army

Incl
as

INSTRUCTIONS
TO THE
ARMY MATERIEL ACQUISITION REVIEW COMMITTEE (AMARC)

PURPOSE: To assess the current Army organization and procedures for Materiel Acquisition and make recommendations for improvement. The goal is an organization and procedure which:

1. Is responsive to the needs of the Army in the field, assuring that effective equipment is introduced into the inventory in an efficient and timely manner,

2. Requires fewer personnel and less Army owned/or operated facilities,

3. Is a proper balance in the distribution of field and headquarters personnel,

4. Is a proper balance between in-house and contract operations,

5. Will result in the development, fabrication and user verification of hardware items more closely meeting established requirements prior to the heavy production involvement which has characterized our recent past history.

ORGANIZATION: (Chart 1)

The study will be conducted under the general supervision and guidance of a Steering Group composed of:

Under Secretary of the Army - Chairman

Vice Chief of Staff of the Army - Vice Chairman

Assistant Secretary of the Army (R&D) - Member

Assistant Secretary of the Army (I&L) - Member

The Steering Group will obtain advice from the Advisory Panel composed of:

Assistant Secretary of the Army (FM)

CG, Army Materiel Command

CG, Training and Doctrine Command

Assistant Chief of Staff for Force Development

Deputy Chief of Staff for Logistics

Assistant Vice Chief of Staff

Chief of Research and Development

The effort will be directed by:

Director - Dr. Wendell B. Sell

Deputy Director - Major General Frank A. Camm

and organized into teams as follows:

Requirements and Concepts Team

Development Team

Production Team

Costing Team

Testing Team

Science and Technology Team

Each team will be composed of a civilian chairman and two or three civilian associate chairmen who will serve on a part-time basis. Each team will have a full time staff, consisting of an Army officer (Executive Officer) and two consultants, to provide administrative support, factual data and analyses as required. The staff

consultants will be composed of at least four industry oriented personnel provided by the Army and at least six personnel from outside the Army provided by contract. The Army staff will provide administrative and clerical personnel.

CONDUCT OF THE STUDY:

a. Study Approach

(1) Ascertain the present status of organization and procedures, including the impact of 1972-1973 changes on the materiel acquisition process.

(2) Review findings and recommendations of previous studies of the Materiel Acquisition Process (list to be provided).

(3) Develop case studies of at least six development programs.

(4) Visit key installations and activities. (list to be provided)

(5) Study related activities of NASA, AEC, Navy, Air Force, large Industrial Corporations, and foreign governments including the Soviet Union.

(6) Conduct face-to-face interviews with key personnel in the Army and other organizations, to include DOD, GAO, Congressional Committee Staff, etc. (suggested list to be provided)

(7) Review input-output analyses of each AMC Laboratory (5 year period).

(8) Schedule periodic discussions with the Steering Group and Advisory Panel on status of study and findings.

(9) Study the six specific areas, noted above, and prepare specific recommendations for each area.

(10) Prepare a brief final report integrating findings and recommendations of all teams.

b. Schedule

Approximately 100 days, as shown on Chart 2.

c. Examples of topics to be considered include, but should not be limited to:

o Where can personnel reductions best be made (say a 20% overall cut)?

o Should the Army have separate commands for Materiel Development, Procurement Supply and Maintenance, and Testing?

o How should requirements be formally established, how rigid should performance specifications be, and how can "gold plating" be eliminated?

o How does the Army establish and maintain a strong independent cost estimating capability? How many echelons of review should there be?

o Which AMC laboratories can be closed or consolidated with others?

o How much of AMC laboratory maintenance and operations can be GOCO? How can such a transformation be implemented?

o How much freedom should laboratories have in planning and executing the Science and Technology Base?

o What criteria should apply in selection of Program Managers? Should they be the same for Military and Civilian Program Managers? What revisions in personnel policies are appropriate for Program Managers?

o How much stability should there be in personnel assignments, military and civilian?

o Are test boards needed? If so, how many and what should their functions be?

o What should be the reporting chain for the various test activities?

o How much of proving ground, range, and similar test activity operations can be by contract?

o Can we close some of our test facilities? If so, which?

o Which arsenals can be closed or consolidated with others?

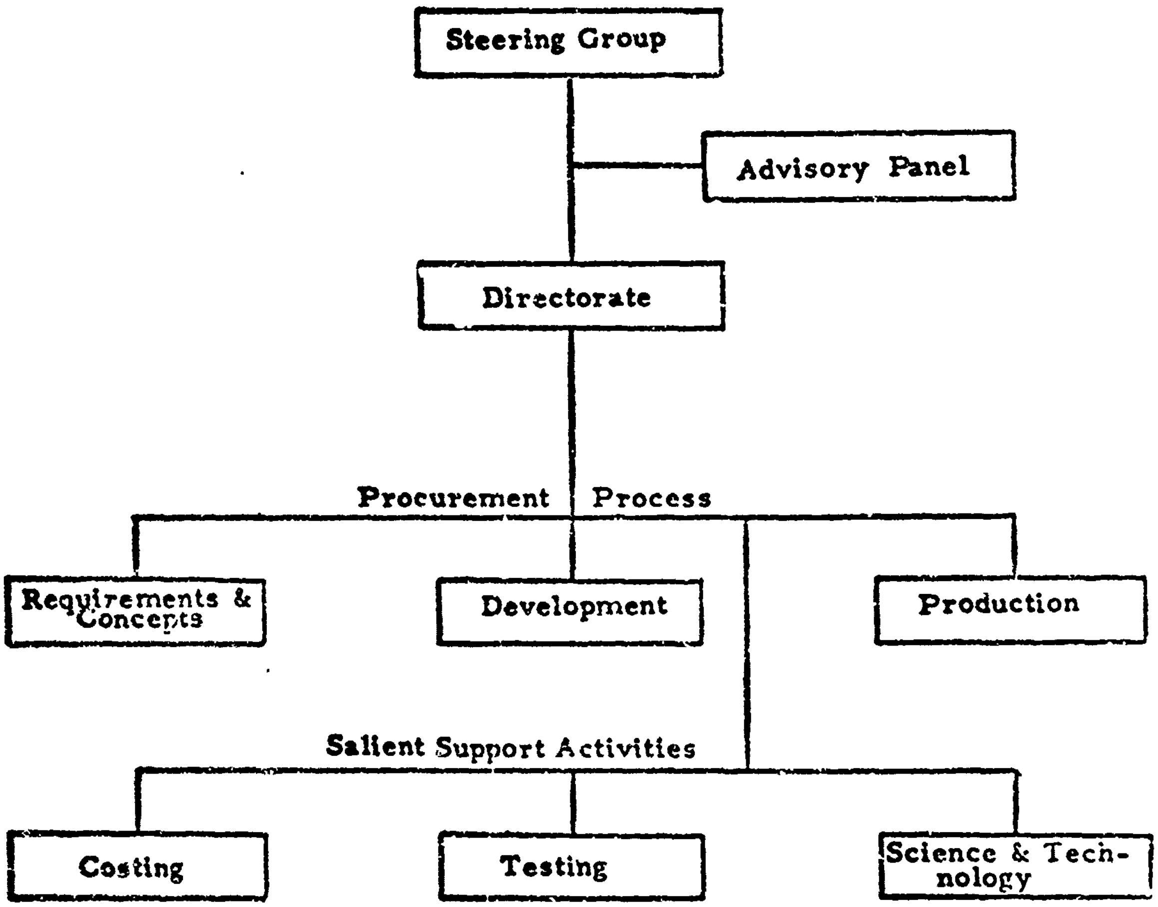
o Can any or all of the arsenals be GOCO? If so, how should this be implemented?

o Is an R&D Staff needed at Commodity Command (or intermediate) headquarters? If so, what should the size be, and what should it do?

o To what degree does the user influence the process? How should this be modified?

2 Incl
as

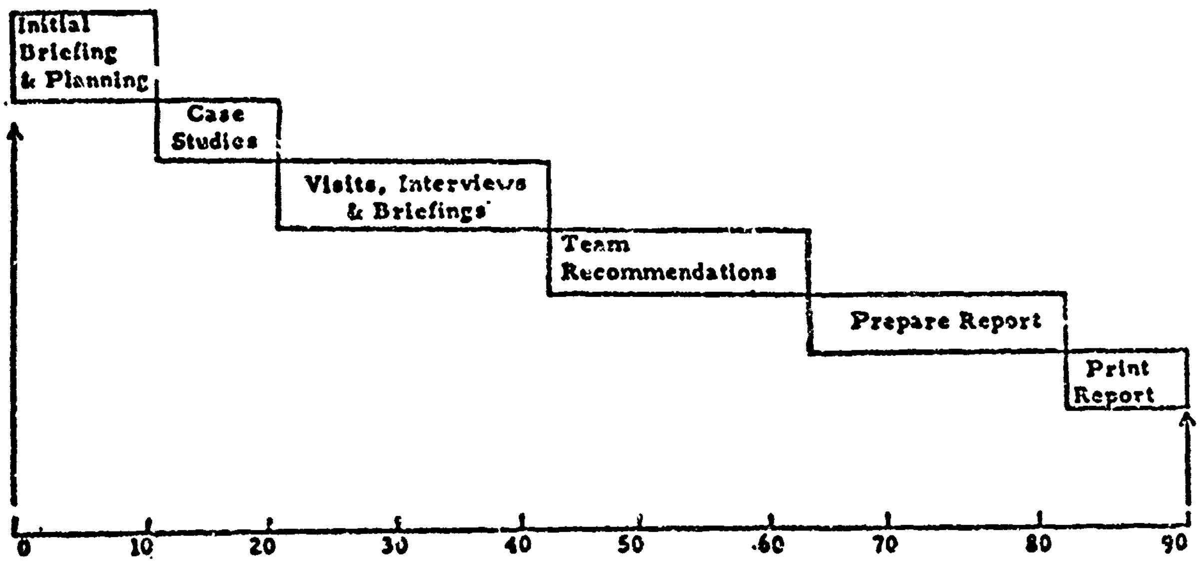
ARMY MATERIEL ACQUISITION REVIEW COMMITTEE (AMARC)



Inclosure 1

Army Materiel Acquisition Review Committee

100 DAY STUDY



Add 10 Days For Briefing Findings

Chart 2.

APPENDIX B
MEMBERSHIP

Members of Army Materiel Acquisition Review Committee

Director's Office

Dr. Wendell B. Sell - President and Chief Executive Officer, Hoffman Electronics Corporation; 1965-69, President and Chief Executive Officer of Packard Bell Electronics; Major General, USAF Reserve.

Major General Frank A. Camm - Assigned to Office, Chief of Staff, Army; 1972-73, Assistant General Manager (Military Applications) Atomic Energy Commission; 30 years service in U.S. Army.

Dr. William M. Duke - Chairman of the Board, Tasker Industries, Dynasciences Corporation, Will Duke and Associates, Interconnect Resources Inc., Systemation Inc., and Modulearn Inc., Los Angeles, California; 1964-70, President, Whittaker Corporation, Los Angeles.

Requirements & Concepts Team

Dr. Thomas S. Amlie - Acting Chief, Advanced Concepts Staff, Office of Systems Engineering Management of Federal Aviation Agency; 1952-70, Naval Weapons Center.

Dr. William H. Pickering - Director, Jet Propulsion Laboratory; 1936-51, Instructor and Professor, California Institute of Technology.

Mr. Haskell G. Wilson - Recently retired as Technical Director, Naval Weapons Center, after 23 years service there.

Development Team

Mr. Oliver C. Boileau, Jr. - President, Boeing Aerospace Company; 1968-71, General Manager of Boeing Missile Division responsible for Minuteman and SRAM missiles; 1971 to present, Member of Defense Science Board (DOD).

Mr. Daniel J. Fink - Vice President and General Manager, Space Division, General Electric Company; 1963-67, Office of Director of Defense Research and Engineering; Member of Army Scientific Advisory Panel.

Support Staff of Army Materiel Acquisition Review Committee

Director's Office

Brigadier General Bennett L. Lewis - Chief, Requirements and Development Division, J-5, Organization of Joint Chiefs of Staff; 1969-72, Commander, Mobility Equipment Research and Development Center and Director RD&E, Mobility Equipment Command; 25 years service in US Army.

Colonel Louis C. Wagner, Jr. - Deputy Director, Materiel Programs Directorate, Office, Chief of Staff, Army; 1971-72, Advisor to Vietnamese Infantry and Armor Units, Military Assistance Command, Vietnam; 19 years service in US Army.

Requirements and Concepts Team

Colonel John F. Brewer, Jr. - Division Chief, Systems Management Division, Doctrine and Organization Directorate, Office of the Assistant Chief of Staff for Force Development, DA; 1970-71, Advisor to Deputy Director General of Highways, Ministry of Public Works, Military Assistance Command, Vietnam; 21 years service in US Army.

Mr. William H. Connerat - Senior Research Analyst, Operations Analysis Division, General Research Corporation; 1963-72, Senior Research Analyst, Logistics and Resources Analysis Divisions, Research Analysis Corporation.

Mr. Francis W. Shepherd - Point of contact with Logistics Management Institute (LMI); Presently Senior Project Director, LMI; 1963-66, Planning Staff Engineer, Honeywell, Inc.

Development Team

Colonel Robert L. Moore - District Engineer, Buffalo District, Corps of Engineers; 1969-72, Director, Plans and Analysis, US Army Materiel Command; 21 years service in US Army.

Mr. Charles B. Einstein - GS-14; Management Analyst, Army Materiel Command; 1965-70, Program Analyst, US Army Materiel Command; 1963-65, Review and Analysis Officer, US Army Materiel Command; 20 years with Civil Service.

Mr. Warren C. Heintzelman - GS-15; Chief, Installations Logistics Support Division, US Army Materiel Command; 1969-72, US Army Materiel Command, Europe; 1965-69, served as a deputy project manager; 24 years with Civil Service.

Mr. Theodore V. Liss - Point of contact with the Logistics Management Institute (LMI); Senior Project Director, LMI; 1966-68, Senior Research Associate, LMI; 1968-69, Executive Vice President, Eyler Associates.

Production Team

Lieutenant Colonel Fred E. Elam - Special Projects Directorate, Office, Chief of Staff, Army; 1970-72, Director, Depot and Transportation Management Department, U.S. Army Logistics Management Center; 14 years service in US Army.

Mr. William L. Clemons, GS-15; Acting Deputy Director, Requirements and Procurement Directorate, Headquarters, U.S. Army Materiel Command (AMC); April-August 73, Acting Chief, Procurement Policy Division, Headquarters, AMC; 32 years of combined Military and Civil Service.

Mr. Robert L. Stohlman, GS-15; Special Assistant for Major Weapon System Acquisition, Office, Deputy Assistant Secretary of the Army (Installations and Logistics); 16 years with Civil Service.

Costing Team

Lieutenant Colonel William J. Fiorentino - Staff Officer, Office, Chief of Research and Development, Army; 1969-71, Instructor, Defense Weapons Systems Management Center; 1966-68, R&D Coordinator, ARPA; Member, US Army R&D Career Field; 17 years service in US Army.

Mr. Joseph W. Noah - President, J. Watson Noah Associates, Inc.; resource analyst since 1958; Active Duty, US Air Force 1951-58.

Mr. C. David Weimer - Point of contact with Institute for Defense Analyses; 1960-69, Program Manager Space Propulsion, United Aircraft Corp.; Member of Defense Science Board Panel on Avionics and ODDR&E Electronics-X Study Team.

Testing Team

Colonel Theodore C. Williams, Jr. - Chief, Operational Test and Evaluation Agency Coordinating Office, Office of the Assistant Chief of Staff for Force Development, Army; 1973-74, US Army Operational Test and Evaluation Agency; 26 years service in US Army.

Mr. F. Donald Genova - Senior Analyst, General Research Corporation; 1960-65, Test Engineer, AVCO Corporation Test and Evaluation Directorate; 1958-60, Raytheon Company; 1956, General Motors Corporation.

Dr. Eugene W. Lewis - Staff Scientist, System Planning Corporation; 1969-72, Institute for Defense Analyses; 1956-69, many jobs in RDT&E at North American Rockwell Corporation and the Bendix Corporation.

Mr. Edward V. Somody - GS-15; Technical Director for Test Operations, US Army Test and Evaluation Command (TECOM); 1962-73, many jobs in field of testing with TECOM as engineer, project officer, test practices and standards, and R&D; 15 years with Civil Service.

Science and Technology Team

Colone' lan A. Nord - AMC Project Manager for SAFEGUARD Munitic .s; 1970-72, Chief of Nuclear Plans, Central Army Group, NATO; 23 years service in the US Army.

Mr. Manfred Gale - Scientific Advisor, Department of the Army; 1968-70, Associate Technical Director, Mobility Engineering Research and Development Center (MERDC); 1966-68, Director, Intrusion Detection and Sensor Laboratory, MERDC.

Dr. Joel Bengston - Point of contact with Institute for Defense Analyses (IDA); 1962-Present, Assistant to President for JASON, Research Staff Member of Science and Technology Division and Research and Engineering Support Division, IDA.

APPENDIX C
AMARC METHODOLOGY

1. Equipped with their initial perceptions, the teams -

a. Did some selected case study probing.

b. Detailed a set of questions appropriate to the study sub area.

c. Conducted visits and interviews.

d. Restructured the questions as the interrogations and visits proceeded.

e. Requested specific relevant data in executive sessions, cross checked the individual observations, evolved a group hypothesis, derived conclusions, and picked solutions.

2. Various team visits were made to all AMC commodity commands, 20 (of 21) AMC laboratories, USATECOM Headquarters and facilities, USACDEC, industrial facilities, Army schools and centers, and numerous other facilities dealing with acquisition. Committee members interviewed personnel in the Department of Defense, Army, Navy, Air Force, GAO, AEC, NASA, industry and other organizations associated with the acquisition systems.

3. At two week intervals, the Directorate met formally with the team chairmen with a meeting format calculated -

a. To have each team check the work and conclusions of the other groups.

b. To permit the directorate to measure and guide progress.

c. To search out areas of overlap.

d. To distill out certain overall conclusions.

e. To prioritize the effort, and the results.

4. It should be noted in passing, that considerable overlap work occurred, primarily because of the fact that many of the Army problems affected the purview of more than one of the teams. In a rough way, this happening provided the Directorate with a crude rank-ordering of problems and solutions, and a source of self check on the Directorate's own research into the more general aspects of the problem.

APPENDIX D
ABBREVIATIONS AND ACRONYMS

-A-

AAH . . . . Advanced Attack Helicopter

ACSI . . . . Assistant Chief of Staff for Intelligence, Army

ACSC-E . . . . Assistant Chief of Staff for Communications-Electronics, Army

ACSFOR . . . . Assistant Chief of Staff for Force Development, Army

ADP . . . . Advanced Development Plan

AMARC . . . . Army Materiel Acquisition Review Committee

AMC . . . . United States Army Materiel Command

AMMRC . . . . Army Materials & Mechanics Research Center

AMP . . . . Army Materiel Plan

AMSAA . . . . Army Materiel System Analysis Agency, AMC

AR . . . . Army Regulation

ARMCOM . . . . . . US Army Armament Command

ASA . . . . US Army Security Agency

ASAP . . . . Army Scientific Advisory Panel

ASA (FM) . . . . Assistant Secretary of the Army (Financial Management)

ASA (I&L) . . . . Assistant Secretary of the Army (Installations and Logistics)

ASA (M&RA) . . . . . Assistant Secretary of the Army (Manpower and Reserve Affairs)

ASA (R&D) . . . . . . Assistant Secretary of the Army (Research and Development)

ASARC . . . . Army Systems Acquisition Review Council

ASD (C)/ASD(Comp). . Assistant Secretary of Defense (Comptroller)

ASD (I) . . . . Assistant Secretary of Defense (Intelligence)

ASD (I&L) . . . . . . Assistant Secretary of Defense (Installations and Logistics)

ASD (M&RA) . . . . Assistant Secretary of Defense (Manpower and Reserve Affairs)

ASD (PA&E) . . . . Assistant Secretary of Defense (Program Analysis and Evaluation)

ASPR . . . . Armed Services Procurement Regulation

AVCSA/AVCS . . . . Assistant Vice Chief of Staff, US Army

AVSCOM . . . . . . US Army Aviation Systems Command

-B-

BUSHMASTER . . . Vehicle Rapid Fire Weapon System - Successor

-C-

CAA . . . . US Army Concepts Analysis Agency

CAIG . . . . Cost Analysis Improvement Group, OSD

CARDS . . . . Catalog of Approved Requirements Documents

CDEC . . . . US Army Combat Development Experimentation Command

CECDC . . . . Cost Estimate Control Data Center

CFP . . . . Concept Formulation Package

CG . . . . Commanding General

COA . . . . Comptroller of the Army

COE . . . . Chief of Engineers

COEA . . . . Cost and Operational Effectiveness Analysis

CPO . . . . Civilian Personnel Office

CRD . . . . Chief of Research and Development, US Army

CSA . . . . Chief of Staff, US Army

-D-

DA . . . . Department of the Army

DAS . . . . Director of the Army Staff (after Reorganization)

DCG . . . . Deputy Commanding General

DCP . . . . Development Concept Paper

DCSLOG . . . . Deputy Chief of Staff for Logistics, Army

DCSOPS . . . . Deputy Chief of Staff for Operations and Plans (after Reorganization)

DCSPER . . . . Deputy Chief of Staff for Personnel

DCSRDA . . . . Deputy Chief of Staff for Research, Development and Acquisition (after Reorganization)

DEAC . . . . Defense Economic Analysis Council

DDRE/DDR&E . . . . Director of Defense Research and Engineering

DEPSECDEF	Deputy Secretary of Defense
DOD	Department of Defense
DODD	Department of Defense Directive
DSA	Defense Supply Agency
DSARC	Defense Systems Acquisition Review Council
DT	Development Testing
DTC	Design-to-Cost
DTUPC	Design to Unit Production Cost

-E-

ECOM	US Army Electronics Command

-F-

FDT&E	Force Development Test and Experimentation
FORSCOM	US Army Forces Command
FY	Fiscal Year
FYDP	Five-Year Defense Program

-G-

GAO	General Accounting Office
GOCO	Government-Owned, Contractor-Operated
GOGO	Government-Owned, Government-Operated

-H-

HDL . . . . Harry Diamond Laboratories

HLH . . . . Heavy Lift Helicopter

HQDA . . . . Headquarters, Department of the Army

-I-

IPCE . . . . Independent Parametric Cost Estimate

ILIR . . . . In-House Laboratory Independent Research

ILSP . . . . Integrated Logistic Support Plan

IOC . . . . Initial Operational Capability (date)

IPP . . . . Industrial Preparedness Planning

IPR . . . . In-Process Review

-L-

LCC . . . . Life Cycle Costs

LOI . . . . Letter of Instructions

-M-

M-Day . . . . Mobilization Day

MALOR . . . . Mortar Artillery Locating Radar

MASSTER . . . . . . Modern Army Selected Systems Evaluation and Review

MERDC . . . . Mobility Equipment Research and Development Center

MICOM . . . . US Army Missile Command

MICV . . . . Mechanized Infantry Combat Vehicle

MILSPECS/STD . . Military Specifications and Standards

MN . . . . Materiel Need

MN (ED) . . . . . . Materiel Need (Engineering Development

MPD . . . . Materiel Programs Directorate, Office, Chief of Staff, Army

-N-

NASA . . . . National Aeronautics and Space Administration

NATO . . . . North Atlantic Treaty Organization

-O-

OACSFOR . . . . . . Office, Assistant Chief of Staff for Force Development

OCA . . . . Office, Comptroller of the Army

OCO . . . . Operational Capability Objective

OCRD . . . . Office, Chief Research and Development

ODCSLOG . . . . . . Office, Deputy Chief of Staff for Logistics

OMA/O&M . . . . . . Operation and Maintenance, Army

OMB . . . . Office of Management and Budget

OPMS . . . . Officer Personnel Management System

OSD . . . . Office of the Secretary of Defense

OT . . . . Operational Testing

OTEA . . . . US Army Operational Test and Evaluation Agency

-P-

PBP . . . . Production Base Plan

PEMA . . . . Procurement, Equipment and Missiles, Army

PM . . . . Project Manager

POM . . . . Program Objective Memorandum

-Q-

QMR . . . . Qualitative Materiel Requirement

-R-

R&D . . . . Research and Development

RAM . . . . Reliability, Availability and Maintainability

RC . . . . Relative Cost

RD&E . . . . Research Development and Engineering

RDTE/RDT&E . . . Research, Development, Test and Evaluation

RE . . . . Relative Effectiveness

REFLEX . . . . . . Resource Flexibility (X vs people)

RFP . . . . Request for Proposal

RIF . . . . Reduction in Force

ROC . . . . Required Operational Capability

RW . . . . Relative Worth

-S-

SA	Secretary of the Army
SAFSEA	US Army SAFEGUARD System Evaluation Agency
SAM-D	Surface to Air Missile - Development
SAR	Selected Acquisition Report
SAWS	Squad Automatic Weapons System
SCOUT	Armored Reconnaissance Scout Vehicle (ARSV)
SECDEF	Secretary of Defense
SMC	Supply and Maintenance Command
SPEF	Single Program Element Funding
STRATCOM	US Army Strategic Communications Command

-T-

TACOM	US Army Tank Automotive Command
TDP	Technical Data Package
T&E	Test and Evaluation
TECOM	US Army Test and Evaluation Command
TF	Task Force
TOAMAC	The Optimum Army Materiel Command
TRADOC	US Army Training and Doctrine Command
TROSCOM	US Army Troop Support Command
TSARC	Test Schedule and Review Committee

-U-

USARAL . . . . . . US Army, Alaska

USARPAC . . . . . US Army, Pacific

USofA . . . . Under Secretary of the Army

-V-

VCSA. . . . . Vice Chief of Staff, US Army

-W-

WBS . . . . Work Breakdown Structure

APPENDIX E

BIBLIOGRAPHY

BIBLIOGRAPHY

It is realized that many of the ideas presented in this report have appeared elsewhere. The Bibliography should serve to delineate AMARC's search of similar efforts in the development, acquisition, and procurement areas.

Letter designators are used to categorize the references as follows:

<u>A</u> Material obtained during informational research.

<u>B</u> Texts which bear on the US Army's and US Government's approach to materiel acquisition.

<u>G</u> Material given AMARC as a package of initial information.

<u>R</u> Relevant public law and study reports used to check the feasibility of recommendations.

<u>W</u> DOD and Service regulations and related material.

ADDITIONAL REFERENCES SEARCHED OUT & VARIOUSLY UTILIZED

A-1. Need for Management Improvement in Expediting Development of Major Weapons Systems Satisfactory for Combat Use. Department of the Army, draft GSO report, 7 February 1969.

A-2. Project Manager Promotions to General Office: AMC-PM Fact Sheet, 7 November 1973.

A-3. Report of the HASC Armed Services Investigating Subcommittee on the Army Tank Program, 9 July 1969.

A-4. Harman, A. J., Analysis of Aircraft Development, p. 4976, Rand Corporation Report, March 1973.

A-5. Glennan, T. K., Jr., Marshak, T., Summus, R., Strategy for R&D Studies in the Microeconomics of Development, Springer-Verlag, New York, 1967.

A-6. Nelson, R. R., Economics of Parallel R&D Efforts: A Sequential Decision Analysis, Rand Corporation Report RM-2482-PR, November 1959.

A-7. Meckling, W. H., Methesne, E. G., Military Research and Development Policies, Rand Corporation Report R-333-PR December 1958.

A-8. Perry, R., A Prototype Strategy for Aircraft Development, Rand Corporation Report RM-5597-1-PR, July 1972.

A-9. Klein, B. H., Glennan, T. K., Jr. & Shubert, G. H., The Role of Prototypes in Development, Rand Corporation Report RM-3467-PR, April 1971.

A-10. Harman, A. J., Henrichsen, S., A Methodology for Cost Factor Comparison and Prediction, Rand Corporation Report RM-6269-ARPA; August 1970.

A-11. Harman, A. J., Choice Among Strategies for System Acquisition, p. 4794, Rand Corporation Report, March 1972.

A-12. Putnam, W. D., The Origin of Air Force System Acquisition Management, Rand Corporation Report R-868-PR, August 1972.

A-13. Harman, A., Henrichsen, S., Perry, R., Smith, G., System Acquisition Strategies, Rand Corporation Report R-733-PR/ARPA, June 1971.

A-14. Boren, H. E., Jr., Levenson, G. S., Tihansky, D. P., & Timson, F. S., Cost Estimating Relationships for Aircraft Airframes, Rand Corporation Report, R-761-PR, February 1972.

A-15. Tihansky, D. P., & Timson, F. S., Confidence in Estimated Airframe Costs, Uncertainty Assessment in Aggregate Predictions, Rand Corporation Report R-903-PR, October 1972.

A-16. Glennan, T. K., Jr., Innovation and Product Quality Under the Total Package Procurement Concept, Rand Corporation Report RM-5097-PR, September 1966.

A-17. Fisher, I. N., A Reappraisal of Incentive Contracting Experience, Rand Corporation Report RM-5700-PR, July 1968.

A-18. Fisher, I. N., & Hall, G. R., Risk and the Aerospace Rate of Return, Rand Corporation Report RM-5440-PR, December 1967.

A-19. Alexander, A. J., R&D in Soviet Aviation, Rand Corporation Report R-589-PR, November 1970.

A-20. Campbell, H., Controversy in Soviet R&D: The Airship Case Study, Rand Corporation Report R-1001-PR, October 1972.

A-21. Alexander, A. J., Weapon Acquisition in the Soviet Union, United States and France, presented at the Conference on Comparative Defense Policy, USAF Academy, Colorado, 8 & 9 February 1973.

A-22. Alexander, A. J., Design to Price from the Perspective of the United States, France & The Soviet Union, Rand Corporation Report p. 4967, February 1973.

A-23. Hall, G. R., & Johnson, R. E., Aircraft Co-Production and Procurement Strategy, Rand Corporation Report R-450-PR, May 1967.

A-24. Klein, B. H., Meckling, W. H., & Mesthene, E. G., Military Research & Development Policies, Rand Corporation Report R-333-PR, December 1958.

A-25. "Packard Wary of Industry Diversification," Av'ation Week & Space Technology, 29 January 1973.

A-26. Perry, R., A Dassault Dossier: Aircraft Acquisition in France, Rand Corporation Report R-1148-PR, September 1973.

A-27. Perry, R., Comparisons of Soviet and U. S. Technology, Rand Corporation Report R-827-PR, June 1973.

A-28. Alexander, A. J., & Nelson, J. R., Measuring Technological Change: Aircraft Turbine Engines, Rand Corporation Report R-1017-ARPA/PR, May 1972.

A-29. Shishco, R., Technological Change Through Product Improvement in Aircraft Turbine Engines, Rand Corporation Report R-1061-PR, May 1973.

A-30. Evolution of the United States Army Materiel Command 1962 to 1974, unsigned, undated.

A-31. "Weapons Development Reform: Another Approach to an Old Goal," Aerospace Daily, 28 January 1974.

A-32. Betts, A. W., Scientific Advisory Reviews of BRL, April 1973 and October 1973.

A-33. Research, Development, and Acquisition Management in the Air Force. An Air Force Systems Command study presented to the Air Force Chief of Staff and others, Washington, D. C., March 1969.

A-34. Project Ace - Findings and Action Plans, Air Force Systems Command Report, October 1973.

A-35. Blue Ribbon Defense Panel, Report to the President and the Secretary of Defense, including all appendices. Source: Washington, D. C. Office of the Secretary of Defense.

A-36. Packard, David, Improving the Development and Procurement of New Weapons. Source: Washington, D. C. Office of the Secretary of Defense, January 1972.

A-37. Packard, David, Improvement in Weapons System Acquisition, Memo for the Secretaries of the military departments. Source: Office of the Deputy Secretary of Defense, 31 July 1969.

A-38. Comptroller General, Acquisition of Major Weapon System, B-163058, 18 March 1971.

A-39. McCullough, James, D., Design to Cost Problem Definition, Survey tc Potential Actions and Observations on Limitations, Arlington, Virginia: Institute for Defense Analysis, January 1973.

A-40. Packard, David, Establishment of a Defense Systems Acquisition Review Council. Memo to principal officials of DOD. Source: Washington, D. C. Office of the Deputy Secretary of Defense, 30 May 1969.

A-41. Packard, David, Address at the Armed Forces Management Association Dinner, Los Angeles, 20 August 1970. Source: Washington, D. C. Office of the Assistant Secretary of Defense.

A-42. Senate Committee on Armed Services, Authorizing Appropriations for Fiscal Year 1972 for Military Procurement Research & Development. S Report 92-359 to accompany H.R. 8687, 92nd Congress, 1st Session 1971.

A-43. Rush, Kenneth, An Address at the National Security Industrial Association (NSIA) Cost Symposium, 16 August 1972. Source: Washington, D. C. Office of the Deputy Secretary of Defense.

A-44. Foster, John S., Jr., Impact of the Problem on the Military/Industry Outlook, Symposium Proceedings Cost - A Principal System Design Parameter. Source: Washington, D. C. Armed Forces Management Association, NSIA, 16 & 17 August 1972.

A-45. Schultze, Charles, L., et al, Setting National Priorities, the 1973 Budget. Source: Washington, D. C., The Brookings Institution.

A-46. Marshall, A. W., and Meckling, W. H., Predictability of the Costs, Time & Success of Development, p. 1821. Source: Santa Monica, California, the Rand Corporation, 1959.

A-47. Comptroller General, Theory and Practice of Cost Estimating for Major Acquisitions, B-163058, 24 July 1972.

A-48. House Committee on Government Operations, Policy Changes in Weapons System Procurement, House Report 91-1719, 91st Congress, 2nd Session, December 1970.

A-49. G. A. O. Acquisitions of Major Weapons Systems, B-163058, 6 February 1970, 18 March 1971 and 17 July 1972.

A-50. Commission on Government Procurement, Summary Report, Source: Washington, D. C. Government Printing Office, December 1972. (Including all appendices.)

A-51. Perry, Robert, et al, System Acquisition Strategies, R 733-PR/ARPA. Source: Santa Monica, California, the Rand Corporation, June 1971.

A-52. Rush, Kenneth, Draft DOD Directive, Secretary of Defense Decisions on Major Acquisitions Programs, a memo to principal officials of DOD. Source: Washington, D. C. Office of the Deputy Secretary of Defense, 20 July 1972.

A-53. Coffin, R. E., "Design to Cost: For Defense, Not Just a Buzz Word," Government Executive, December 1973.

A-54. Cameron, J., "The Rethinking of U. S. Defense," Fortune, December 1973.

A-55. Information on AEC, Interface with Concept Formulation and Contract Definition, unsigned, revised June 1970.

A-56. dePoix, Vincent (V. Adm.) Talk given by Deputy Director for Administration, Defense Research and Engineering, at the National Security Industrial Association Research & Engineering Advisory Committee meeting on "Defense Research and Engineering -- Its Reorganization and the Development Process," Washington, D. C., 12 March 1970.

A-57. Schweiker, R., "Better Controls Over Defense Procurement," U. S. Congressional Record, 12 March 1970.

A-58. U. S. Congress, An Act to Establish a Commission on Government Procurement, Public Law 91--29. 91st Congress, 1st Session, 26 November 1969.

A-59. U. S. House of Representatives, The Committee on Armed Services Hearings on Truth in Negotiations, (H. R. 10573) 90th Congress, 2nd Session, 13 March 1968.

A-60. U. S. House of Representatives, The Committee on Government Operations, Hearings on Government Procurement & Contracting, 9 volumes, 91st Congress, 1st Session, 18-27 March 1969.

A-61. U. S. House of Representatives, Commission on Government Procurement, Report #91-468, 91st Congress, 1st Session, 12 August 1969.

A-62. U. S. Senate, Subcommittee on Economy in Government, Joint Economic Committee, The Economics of Military Procurement, May 1969.

A-63. Contract Definition Phase Planning, Does It Work? Data on Defense and Civil Systems, XIV, No. 3, March 1969.

A-64. Ferguson, J., Air Force Systems Management - Back to the Fundamentals, Defense Industry Bulletin, January 1970.

A-65. Hall, R. B., "The Armed Services Procurement Act of 1947 Should be Reformed," National Contract Management Journal, Spring 1969/

A-66. Hall, G. R., Interaction of Procurement Decisions in Weapon System Acquisition Projects, Rand Report, p. 4105, June 1969/

A-67. Aerospace Research Center Report, Federal Procurement Principles, A Proposal in the National Interest, November 1971,

A-68. Aerospace Research Center Report, National Technology Program, November 1972.

A-69. Aerospace Industries Association Report, Aerospace Profits vs. Risks, June 1971.

A-70. Staats, E. B., Comptroller Comptroller General Report to the Congress, Defense Industry Profit Survey, March, 1971.

A-71. Harbridge House, Inc., A Report to the Office of DDR&E, A Study of Requirements [illegible] Data & Management Control Systems in Three Engineering Pr[illegible]ams, February 1970.

A-72. Weidenbaum, M. L., "Arms & The American Economy: A Domestic Convergence Hypothesis," American Economic Review, Vol. LVIII, No. 2, 1968.

A-73. VomBaur F. T., "Fifty Years of Government Contract Law," Federal Business Journal, Vol. 29, 4 November 1970.

A-74. SRI Special Report, The Industry-Government Aerospace Relationship, May 1963.

A-75. Logistics Management Institute Report, Defense Industry Profile Review, March 1970.

A-76. Grossbaum, J. J., "Procedural Fairness in Public Contracts: The Procurement Regulations," Virginia Law Review, March 1971.

A-77. AFMA/NSIA Proceedings, Symposium on Cost - A Principal System Design Parameter, 16-17 August 1972.

A-78. Weidenbaum, M. L., The Modern Public Sector: New Ways of Doing the Government's Business, Basic Books, Inc., 1969/

A-79. Spiro, H. T., Optimal Organization of the Military Hardware Industry, UCLA, 1972.

A-80. U.S. Air Force, Policies, Responsibilities & Procedures for Obtaining New and Improved Operational Capabilities, AFR 57-1.

A-81. U. S. Air Force, Concept Formulation & Contract Definitions of Development Projects, AFR 80-20, 24 July 1967.

A-82. U.S. Air Force, Management of Systems Programs, AFR 375-1, 6 March 1970, (Change 1, 17 April 1970).

A-83. U.S. Air Force, System Program Office, AFR 375-2, 6 March 1970.

A-84. U.S. Air Force, System Program Documentation, AFR 375-4. 6 March 1970 (Change 1, 17 April 1970, Change 2, 27 May 1970).

A-85. U.S. Air Force, Source Selection Procedures, AFM 70-10, January 1968, (Change 1, 1 April 1970, Change 2, 21 April 1970).

A-86. U. S. Air Force, Systems Command, Letter to AFJC Command, "Program Management," 1 October 1969.

A-87. Comptroller General of the U. S., Evaluation of Two Proposed Methods for Enhancing Competition in Weapons Systems Procurement, GAO Report B 39995, Washington, D. C., 14 July 1969

A-88. Carrington, M., Problems Involved in System Program Office Use of Incentive Contracts in Acquisition of Defense Systems, Report 0350-67, Air Command & Staff College, Maxwell Air Force Base, Alabama 1967.

A-89. Laird, M. R., Participatory Management, Remarks by the Secretary of Defense printed in Air Force Policy Letter, August 1969/

A-90. Meehan, J. D., Major Weapon Weapon System Acquisition - An Analysis of DOD Management Arrangements, U. S. Air Force Institute of Technology, Dayton, Ohio, September 1968.

A-91. Frosch, R. A., Procurement of Research & Development, address at George Washington University/Federal Bar Association, 16th Annual Institute on Government Contracts, Washington, D. C., 8 May 1969.

A-92. Roscoe, R. I., The Contract Definition Phase - Can Industry Afford It? Industrial College of the Armed Forces, Fort McNair, Washington, D. C., March 1969.

A-93. Friedman, M., "Volunteer Armed Force, Failure or Victim?" Newsweek, 11 February 1974, p. 82.

A-94. Huff, J. H., "Army Project Management - A Career Field?" PMC 73-2, Study Report.

A-95. Army Materiel Command - Project Management, USA META, November 1972.

A-96. Featherstone, F. H., The Business of Project Management U. S. Naval Institute Proceedings, January 1972.

A-97. Richardson, E. L., Secretary of Defense's Annual Defense Department Report, Fiscal Year 1974.

BOOKS

B-1. Blau, P.M., The Dynamics of Bureaucracy. Chicago: University of Chicago Press, 1955.

B-2. __________ Bureaucracy in Modern Society. New York: Random House, 1956.

B-3. Blau, P.M. & Scott, W. R. Formal Organization: A Comparative Approach. San Francisco: Chandler Publishing Co., 1962

B-4. Brodie, B. Strategy in the Missile Age. Princeton: Princeton Univ. Press, 1959

B-5. Burns, T. & Stalker, G.M., The Management of Innovation. London: Tavastock, 1961

B-6. Carter, C. F. & Williams, B.R., Industry & Technical Progress: Factors Governing the Speed of Application of Science. London: Oxford Univ. Press, 1957

B-7. Carter, D., The Fourth Branch of Government. Boston: Haughton Mifflin Co., 1959.

B-8. Cline, R.S., Washington Command Post: The Operations Division Washington, D.C.: Department of the Army, 1951

B-9. Doctors, S., The Role of Federal Agencies in Technology Transfer. Cambridge: MIT Press, 1969

B-10. Enos, J. L., in the Rate & Direction of Inventive Activity: Economic and Social Factors. R. R. Nelson, Ed. Princeton: Princeton University Press, 1962, pp 299-322.

B-11. Etzioni, A., A Comparative Analysis of Complex Organizations. New York: The Free Press of Glencoe, 1961

B-12. Finletter, T. K., Power & Policy: U. S. Foreign Policy & Military Power in the Hydrogen Age, New York: Harcourt, Brace & Co., 1954.

B-13. Gavin, J. M. War and Peace in the Space Age. New York: Harper & Bros., 1958

B-14. Ginsburg, E. & Reilley, E. W., Effecting Change in Large Organizations, New York: Columbia University Press, 1957

B-15. Gruber, W. H. & Marquis, D. G., Factors in the Transfer of Technology. Cambridge: MIT Press 1969

B-16. Hammond, P. Y., Organizing for Defense: The American Military Establishment in the Twentieth Century. Princeton: Princeton University Press

B-17. Hitch, C. J. & McKean, R. N., The Economics of Defense in the Nuclear Age. Cambridge: Harvard Univ Press, 1960

B-18. Hittle, J. D., The Military Staff: Its History & Development Rev Ed., Harrisburg: Stackpole, 1960

B-19. Huntington, S. P., The Soldier & The State., 2nd Ed. Cambridge: Harvard Univ Press., 1859

B-20. ________ The Common Defense: Strategic Programs in National Politics, New York: Columbia Univ Press, 1961

B-21. Huzar, E., The Purse & The Sword: Control of the Army by Congress thru Military Appropriations, 1933-1950. Ithaca: Cornell Univ Press, 1950

B-22. Janowitz, M., Sociology & The Military Establishment, New York: Russel Sage Foundation, 1959

B-23. ____________, The Professional Soldier: A Social & Political Portrait, Glencoe: The Free Press, 1959

B-24. Jewkes, J., Sawyers, D., Stillerman, R., The Sources of Invention. London: MacMillan, 1958

B-25. Klintner, W. R., Forging a New Sword: A Study of the Department of Defense. New York: Harper & Bros, 1958

B-26. Kissinger, H. A., Nuclear Weapons & Foreign Policy, New York: Harper & Bros, 1957.

B-27. __________, The Necessity for Choice, New York: Harper & Bros, 1960.

B-28. Langrish, J., Gibbons, M., Evans, G. & Jercne, F. R., Wealth from Knowledge, New York: 1972.

B-29. Leach, B., Scientific Techniques & Science Policy, Manchester: Univ of Manchester Bus. School, 1971

B-32. Miller, R. E., Innovation, Organization & Environment, Sherbrooke, Quebec: Univ of Sherbrook Press, 1971

B-30. Mansfield, E. , Industrial Research and Technological Innovation: An Econometric Analysis, New York: Norton 1968

B-31. ____________, The Economics of Technological Change. New York: Norton, 1968

B-33. Norton, J. R., Organizing for Innovation: A Systems Approach to Technical Management, New York: McGraw Hill, 1971.

B-34. Mueller, F. F. in The Rate & Direction of Inventive Activity: Economic and Social Factors, E. R. Nelson, Ed., Princeton: Princeton Univ Press 1962

B-35. Nelson, O. L., National Security & The General Staff, Washington: Infantry Journal Press, 1946

B-37. Pace, D. F., Negotiation and Management of Defense Contracts, New York: Wiley Interscience Publishers, 1970

B-36. OECD, The Conditions for Success in Technological Innovation, Paris: Organization for Economic Cooperation & Development, 1971

B-38. Reis, J. C., The Management of Defense: Organization & Control of the U. S. Armed Services, Baltimore: Johns Hopkins Press, 1964

B-39. Rogers, E. M., Diffusion of Innovations, New York: Free Press, 1962

B-40. __________, Shoemaker, F. F., Communication of Innovation, New York: Free Press, 1971

B-41. Sr...pson, R. C., The Staff Role in Management, New York: Harper & Bros, 1955

B-42. Schilling, W. R., Hammond, P. Y. & Snyder, G., Strategy, Politics, & Defense Budgets, New York: Columbia Press, 1962

B-43. Simon, N. A., Administrative Behavior: A Study of Decision Making Processes in Administrative Organization, New York: The Macmillan Co. 1951

B-44. St..., T. W., American Defense & National Security, Washington, D. C.: P... Affairs Press, 1956

B-45. Stein, H. (Ed), American Civil-Military Decisions, A Book of Case Studies, New York: The Twentieth Century Fund, 1963

B-46. Sternberg, F., The Military & Industrial Revolution of Our Time, London: Stevens & Sonce, Ltd., 1959

B-47. Stockfish, J. A., Plowshores Into Swords: Managing the American Defense Establishment., New York: Mason & Lipscom, 1973

B-48. Suits, C. G. & Bueche, A. M., in Applied Science & Technological Progress, H. Brooks et al, Eds. (Govt Printing Office, Washington, D. C.) 1967, pp 297-346

B-49. Taylor, M., The Uncertain Trumpet, New York: Harper & Bros., 1959

B-50, Vagts, A., History of Militarism, New York: Meridian Books, Inc., 1959

B-51. Waskow, A., The Limits of Defense, Garden City: Doubleday, 1962

B-52. White, L. D., Introduction to the Theory of Public Administration New York: The Macmillan Co., 1950

B-53. ____________, The Republican Era: 1869-1901, New York: The Macmillan Co., 1958

B-54. Whate, L. J., The Automobile Industry Since 1945., Cambridge: Harvard Univ Press, 1971

REFERENCES GIVEN TO AMARC

G-1. D. A. Document, Information for Industry, undated but signed by J. R. Deane, Jr.

G-2. D. A. Memo for Major Army Commanders and Heads of Army Staff Agencies, Materiel Acquisition Guidelines, 20 June 1972, signed by W. C. Westmoreland, R. F. Froehlke.

G-3. Summary of the Report of the Commission on Government Procurement, December 1972.

G-4. A Concise History of the M16 Weapon System, unsigned, undated. declassified.

G-5. A Concise History of the COBRA Helicopter Program, unsigned, undated, "official use only" document.

G-6. A Concise History of the Army Attack Helicopter Program, unsigned, undated, "official use only" document.

G-7. A Concise History of the Development of the M60 Tank, unsigned, undated.

G-8. A Concise History of U.S. Army Tank Development (MBT 70), unsigned, undated.

G-9. A Concise History of the Sheridan Weapon System, unsigned, undated.

G-10. A Concise History of the Shillelagh Weapon System, unsigned, undated.

G-11. Data Sheet for X-M1 Tank System, 17 December 1973, unsigned.

G-12. Fact Sheet on All-Weather SHORAD Background, 26 December 1973.

G-13. Description and History of Advanced Attack Helicopter, undated.

G-14. A Concise History of the TOW Weapon System, unsigned, undated.

G-15. Summarization of 37 AMC Projects and Project Managers, unsigned, undated.

G-16. A Concise History of Artillery Improved Conventional Munitions, unsigned, undated.

G-17. GAO Report, Cost Growth of Major Weapons Systems, 26 August 1973.

G-18. Summary of Basic Policies for Systems Acquisition by the Department of the Army, unsigned, undated.

G-19. Selected Extracts from Report to the President and the Secretary of Defense on the Department of Defense, Blue Ribbon Defense Panel, 1 July 1970.

G-20. Bucy, J. E. et al, Office of DDR&E, Defense Science Board Report of the Task Force on Reducing Costs of Defesne Systems Acquisition, Design to Cost Commercial Practice vs Department of Defense Practice, 15 March 1973.

G-21. The Evolution of Operational Test and Evaluation in the Army Materiel Acquisition Process, unsigned, 29 October 1973.

G-22. Report of Audit, Suitability Testing Within the U.S. Army, U. S. Army Audit Agency, October 1971.

G-23. Operational Service Testing, AR 70-10, July 1971.

G-24. Defense Acquisition Study, NSIA Report, 1 July 1970.

G-25. Briefing to AMARC on Arsenals, unsigned, 11 January 1974.

G-26. Smith, H. D., Briefing to AMARC, Logistics Support of Army Systems, 14 January 1974.

G-27. Briefing to AMARC, Evolution of AMC, unsigned, 11 January 1974.

G-28. Briefing to AMARC on AMC Role, unsigned, 14 January 1974.

G-29. Briefing to AMARC on AMC Laboratories, unsigned, undated.

G-30. Briefing to AMARC, The Commodity Commands, unsigned, undated.

G-31. Staats, E. B., Comptroller General, Report to the Committee on Armed Services, House of Representatives, Cost Growth in Major Weapons Systems, 20 March 1972.

G-32. Staats, E. B., Comptroller General, Report to the Congress, Financial Status of Selected Major Weapon Systems, 13 November 1973.

G-33. Summary of the Report of the Commission on Government Procurement, unsigned, December 1972.

G-34. Monopsony, A Fundamental Problem in Government Procurement, Orkand Corporation Report, May 1973.

G-35. Acquisition of Major Defense Systems, DOD Directive 5000.1, July 1971.

G-36. Hardesty, B. D., Recommendations for Development of Major Defense Systems, DODD 5000X, and Solutions to Design Complexity and Cost Problems, Special Task Group R&E Advisory Committee, NSIA, October 1973.

G-37. Shillito, B. J., "How to Implement Our Sound Weapons Systems Acquisition Policies," Defense Management Journal, Fall 1971.

G-38. U. S. Army Regulation, Basic Policies for Systems Acquisition by the Department of the Army, AR 1000-1.

G-39. HQDA letter, 23 August 1972, subject: Letter of Instructions (LOI) Implementing AR 1000-1.

RELEVANT STUDIES, PUBLIC LAWS, PUBLIC PROCEDURES

R-1. Aeronautical Depot Maintenance Study Group of 1971

R-2. Capabilities and Capacities Study Group of 1971

R-3. Construction/Engineer Equipment Maintenance Study Group of 1973

R-4. Development of the Interservice (Depot) Maintenance Interrogation System, 1967

R-5.

R-5. FIRF-4 Recoverable Item Service Test, 1969

R-6. Joint Navy/Air Force Logistics Support Plan for F401/F100 Engine, 1970

R-7. DOD Maintenance Study Group (Veal), 1972

R-8. Review of Selected Aspects of Depot Level Maintenance Support of Aircraft, LMI Task 73-2, 1973

R-9. Commission on Govt Procurement Report

R-10. House Committee on Govt Operations Report

R-11. Senate Committee on Armed Services Report

R-12. The Armed Services Procurement Act of 1947

R-13. The Federal Property & Administrative Services Act of 1949

R-14. The Atomic Energy Act of 1946 & 1954

R-15. The National Aeronautics & Space Act of 1958

R-16. Paul, J, US Government Contracts and Subcontracts, The American Law Institute, 1964

R-17. Cuneo, G, Government Contracts Handbook, Machinery & Allied Products Institute 1964

R-18. Navy Contract Law, Second Edition NAV EXOS - P-1995 Office of the General Counsel, Dept of the Navy, 1959

R-19. Defense Procurement Handbook, FM 38-3 NAVMAT P 12410, AFP 70-1-6, DAH 4105-1, 1964

R-20. Nash, R. C. & Cibinic, J., Federal Procurement Law. George Washington University Press, 1964

R-21. Wachtel, I. H., & McBride, J. C., Government Contracts Cyclopedic Guide to Law, Administration, Procedure, New York Mathew Bender, 1966

R-22. Report to the President on Government Contracting for Research & Development, Bu Budget, May 62 ("Bell" Report)

R-23. Report of the Task Group on Defense, In-House Laboratories, DDRE & OSD (Includes the "Glass" Study & the "Lewis" Study)

R-24. Public Law 89-306

DOD/ARMY WORK DOCUMENTS

W-1. U. S. Department of Defense, Initiation of Engineering & Operational Systems Development, DODD 3200.9, July 1969/

W-2. U. S. Department of Defense, Logistic Support, DODI 4100.35, October 1970.

W-3. U. S. Department of Defense, Major System Proposal Evaluation & Source Selection, DODD 4105.62, January 1974.

W-4. U. S. Department of Defense, Tri-Service Standardization, DODD 4120.3, April 1965.

W-5. U. S. Department of Defense, Defense Standardization Manual, DODD 4120-3M, January 1972.

W-6. U. S. Department of Defense, Quality Assurance, DODI 4155.1, February 1972.

W-7. U. S. Department of Defense, Manufacturing Technology, DODI 4200.15, July 1972.

W-8. U. S. Department of Defense, Major Systems Acquisition, Priorities & Allocations, DODI 4400.1, November 1971.

W-9. U. S. Department of Defense, DCP/DSARC Process, DODI 5000.2, Pending.

W-10. U. S. Department of Defense, Test & Evaluation, DODD 5000.3, January 1973.

W-11. U. S. Department of Defense, Policies for the Management & Control of DOD Information Systems, DODD 5000.19, June 1971.

W-12. U. S. Department of Defense, Configuration Management Implementation Guide, DODI 5000.21, August 1968.

W-13. U. S. Department of Defense, Value Engineering, DODD 5010.8, February 1972.

W-14. U. S. Department of Defense, System Program Management, DODD 5010.14, May 1965.

W-15. U. S. Department of Defense, Work Breakdown Structures for Defense Materiel Items, DODD 5010.20, July 1968.

W-16. U. S. Department of Defense, Flexibility in Management of Research & Development Program, DODD 5010.23, January 1969.

W-17. U. S. Department of Defense, Acquisition of Data from Contractors, DODI 5010.29, November 1971.

W-18. U. S. Department of Defense, Data Acquisition Management Program, DODI 5010.29R, March 1973.

W-19. U. S. Department of Defense, IRAD, DODI 5100.66, February 1972.

W-20. U. S. Department of Defense, Functions of the Department of Defense and Its Major Components, DODD 5101.1, December 1968.

W-21. U. S. Department of Defense, Performance Measurement for Selected Acquisitions, DODI 7000-2, April 1972.

W-22. U. S. Department of Defense, Acquisition Management Systems Control, DODI 7000.6, March 1971.

W-23. U. S. Department of Defense, DOD Programming System, Procedures for Program Changes, DODD 7045.2.

W-24. U. S. Department of Defense, Planning, Programming & Budgeting Systems, DODI 7045.7, October 1971.

W-25. Logistics Management Institute, Defense Industry Profit Review. Report 69-27. Washington, D. C., March 1070.

W-26. Logistics Management Institute, Reconnaissance Study of Service Contract Methodology, Washington, D. C., April 1969. (AD 687-451).

W-27. Logistics Management Institute, The Contract Audit/Contract Administration Interface. Report 68-71. Washington, D. C., March 1969. (AD 683-679).

W-28. Logistics Management Institute. A Manager's Guide to the Acquisition of DOD Systems and Equipment. Report 68-13. Washington, D. C., January 1969. (AD 681-700).

W-29. Logistics Management Institute, Contractor Performance Evaluation in Source Selection. Report 69-2. Washington, D. C., October 1968. (AD 676-749).

W-30. Logistics Management Institute, Wage Rate and Material Price Level Adjustment Provisions in DOD Procurement. Report 67-4. Washington, D. C., May 1968. (AD 677-327).

W-31. Logistics Management Institute, An Examination of the Foundations of Incentive Contracting. Report 66-7. Washington, D. C., May 1968. (AD 683-677).

W-32. Logistics Management Institute. Multi-Year Procurement and Learning Curve Effects. Report 67-20. Washington, D. C., October 1967, (AD662-403).

W-33. Logistics Management Institute, Life Cycle Costing in Industry. Report 67-21. Washington, D. C., September 1967. (AD 660-659).

W-34. Logistics Management Institute, Weighted Cuideline Changes and Other Proposals for Incentives for Contractor Acquisitions of Facilities. Report 66-12. Washington, D. C., September 1967. (AD 660-388).

W-35. Logistics Management Institute, Total Package Procurement Concept-Synthesis of Findings. Report 67-3. Washington, D. C., June 1967. (AD 655-814).

W-36. Logistics Management Institute, Multi-Year Procurement at the Subcontractor Level. Report 67-13. Washington, D. C., February 1967. (AD 654-181).

W-37. Logistics Management Institute, Life Cycle Costing in Equipment Procurement. Report 66-3. Washington, D. C., February 1967. (AD 654-181).

W-38. Logistics Management Institute, Procurement Time Navy Complex Items. Report 66-21. Washington, D. C., December 1966. (AD 804-866L).

W-39. Logistics Management Institute, Analysis of Contractor Independent Technical Effort (CITE) Reimbursement Policies. Report 65-26. Washington, D. C., August 1966. (AD 802-989).

W-40. Logistics Management Institute, Study of Profit or Fee Policy. Report 5B1. Washington, D. C., 1965. (AD 472-965).

W-41. Logistics Management Institute, Two-Step Formal Advertising. Washington, D. C., May 1965. (AD 472-968L). (Obtained through ASD/I&L only).

W-42. Logistics Management Institute, Implementation Status -- Multi-Year Procurement. Report 65-14. Washington, D. C., February 1965.

W-43. U. S. Army Regulation, Weapon/Support Systems Cost Categories and Elements, AR 37-18.

W-44. U. S. Army Regulation, Army Research and Development Information System; Program Planning and On-Going Work Reporting. AR 70-9.

W-45. U. S. Army Regulation, Test and Evaluation During Research and Development of Materiel, AR 70-10. (Draft)

W-46. U. S. Army Regulation, System/Project Management, AR 70-17.

W-47. U. S. Army Regulation, Advanced Development Plans/System Development Plans, AR 70-27.

W-48. U. S. Army Regulation, Research & Development Configuration Management, AR 70-37.

W-49. U. S. Army Regulation, User Field Test, Experiments and Evaluation, AR 71-3.

W-50. U. S. Army Regulation, The Army Test and Evaluation Program, AR 71-8.

W-51. U. S. Army Regulation, Product Improvement of Materiel, AR 700-35.

W-52. U. S. Army Regulation, Army Industrial Preparedness Programs, AR 700-90.

W-53. U. S. Army Regulation, Army Research and Development, AR 705-5.

W-54. U. S. Army Regulation, Proposal Evaluation and Source Selection, AR 715-6.

W-55. U. S. Army Regulation, Army Materiel Maintenance Concepts and Policies, AR 750-1.

W-56. U. S. Army Regulation, Systems Acquisition Review Council Procedures, AR 15-14.

W-57. U. S. Army Regulation, Advanced Procurement Planning, MISC/1-2100.

W-58. U. S. Department of Defense, Work Breakdown Structure for Defense Materiel Items, MIL-STD-881.

W-59. U. S. Department of Defense, Configuration Control -- Engineering Changes, Deviations and Waivers, MIL-STD-480, October 1968.

W-60. U. S. Department of Defense, Configuration Control -- Engineering Changes, Deviation and Waivers, (Short Form), MIL-STD-481A, October 1972.

W-61. U. S. Department of Defense, Configuration Status Accounting Data Elements and Related Features, MIL-STD-482, September 1968.

W-62. U. S. Department of Defense, Configuration Management Practices for Systems, Equipment, Munitions and Computer Programs, MIL-STD-483, December 1970.

W-63. U. S. Department of Defense, Specification Practices, MIL-STD-490, October 1968.

W-64. U. S. Department of Defense, Contractor Configuration Management Plans, MIL-STD-1456, January 1972.

W-65. U. S. Department of Defense, Technical Reviews and Audits for Systems, Equipment and Computer Programs, MIL-STD-1521, September 1972.

W-66. U. S. Department of Defense, Joint Service/Agencies Regulation on Configuration Management, MIL-STD-XXX, April 1972.

W-67. U. S. Department of Defense, Specifications, Types and Forms, MIL-S-83490, October 1968.

W-68. U.S. Navy, Configuration Management, Change 1, NAVMATINST 4130.1, November 1968.

W-69. U. S. Air Force, Maintenance Engineering and Supply Configuration Management, Change 1, AFR 65-3, August 1971.

W-70. U. S. Air Force, Configuration Management and Systems Equipment, Munitions, and Computer Programs, Change 1. AFSCM 375-7, July 1971.

W-71. U. S. Air Force, Cost/Schedule Control System, AFSCP/AFLCP 173-5, AMCP 37-5, NAVMAT P5240, March 1972.

W-72. U. S. Department of Defense, Derivation of Estimated Data Process, ASPR-F-200.1423.

W-73. U. S. Department of Defense, DOD Authorized Data List, TD-3.

W-74. U. S. Department of Defense, Engineering Drawing Practices, MIL-STD-100A, October 1967.

W-75. U. S. Department of Defense, Preparation and Submission of Data for Approval of Non-Standard Parts, MIL-STD-749B, December 1970.

W-76. U. S. Department of Defense, Procurement Method Coding of Aeronautical Replenishment Spare Parts, MIL-STD-789A, October 1966.

W-77. U. S. Department of Defense, Tabulated Wiring Data Lists and Pictorial Wiring Programs, MIL-STD-799 (AS), October 1969/

W-78. U. S. Department of Defense, Preparation of Wiring Data, MIL-STD-863, March 1971.

W-79. U. S. Department of Defense, Procurement Data Packages, MIL-STD-885B, November 1971.

W-80. U. S. Department of Defense, Drawings, Engineering and Associated Lists, MIL-D-1000, March 1969.

W-81. U. S. Department of Defense, Data Quality (Army), MIL-T-50301, May 1969.

W-82. U. S. Air Force, Acquisition of Drawings, AFAD 71-700.

W-83. U. S. Air Force, Deferred Requisitioning of Engineering Data, AFSCR 310-2, July 1969.

W-84. U. S. Army, Management of Contractor Data, AFSCR/AFLCR 310-1, October 1971.

W-85. U. S. Department of Defense, Human Engineering Design Criteria for Military Systems, MIL-STD-1472A, May 1970.

W-86. U. S. Department of Defense, Human Engineering Requirements for Military Systems, Equipment and Facilities, MIL-H-46855, August 1971.

W-87. U. S. Department of Defense, Maintainability Program Requirements, MIL-STD-470B, November 1972.

W-88. U. S. Department of Defense, Maintainability Verification/Documentation/Evaluation, MIL-STD-471A, August 1972.

W-89. U. S. Department of Defense, Production Management, MIL-STD-1528, August 1972.

W-90. U. S. Department of Defense, Supplier Quality Assurance Program Requirements, MIL-STD-1535, December 1972.

W-91. U. S. Department of Defense, Quality Program Requirements, MIL-Q-9858A, December 1963.

W-92. U. S. Department of Defense, Contractors Standardization Program, Proposed Revision A, MIL-STD-891, November 1971.

W-93. U. S. Department of Defense, System Engineering Management, MIL-STD-499, January 1970.

W-94. U. S. Department of Defense, Defense System Engineering, MIL-STD-XXX, March 1973.

W-95. U. S. Department of Defense, A Guide to System Engineering, TM 38-760.

W-96. U.S. Air Force, Systems Engineering Management Procedures, AFSCM 375-5, March 1966.

W-97. U. S. Army Regulation, United States Army Training and Doctrine Command (Organization and Functions), AR 10-41.

W-98. U. S. Army Regulation, United States Army Forces Command (Organization and Functions), AR 10-42.

W-99. U. S. Army Regulation, United States Army Concepts Analysis Agency (Organization and Functions), AR 10-38.

W-100. HQDA Letter, 20 July 1973, subject: Combat Development Responsibilities.

W-101. U. S. Army Regulation, Army Research and Development, AR 70-1.

W-102. Catalog of Approved Requirements Documents (CARDS), Classified SECRET, 1 July 1973 (revised quarterly).

W-103. HQDA Letter, 1 October 1973, subject: U. S. Army Materiel Systems Subject to Special Management Procedures (revised quarterly).

W-104. Logistics Management Institute, The Development of Requirements for Major Weapon Systems, Task 73-9, July 1973.

W-105. Annual Posture Reports of Army Materiel Command Laboratories, 1973:

US Army Munitions Command
US Army Human Engineering Laboratory
US Army Tank-Automotive Command
US Army Mobility Equipment Research & Development Center
US Army Missile Command
US Army Materials and Mechanics Research Center
US Army Electronics Command
US Army Aviation Systems Command
US Army Weapons Command
US Army Natick Laboratories
Harry Diamond Laboratories
Ballistics Research Laboratory

W-106. Project REFLEX, An Evaluation at Four Army Laboratories, May 1973.

W-107. Department of Defense Appropriations for 1974, Hearings Before a Subcommittee of the Committee on Appropriations, House of Representatives, Ninety-Third Congress, First Session, Part 7, Research, Development, Test, and Evaluation. (Food Management Report as related to Natick Laboratories).

W-108. Title 10 U. S. Code 2311.

W-109. Title 10 U. S. Code 2304(a)(13).

W-110. AR 18-1 Policies, Objectives, Procedures, and Responsibilities for Management Information Systems, 5 Augues 1971.

W-111. DODD 4105.55, Selection and Acquisition of Automatic Data Processing Resources, 19 May 1972.

W-112. IDA Research Paper P 1023, Problems in Evaluation and Management of Army Laboratories, March 1974.

W-113. Logistics Management Institute Study, Review of Cost-Effectiveness Analysis, Task 74-14, March 1974.

W-114. DODD 4000.19, Basic Policies and Principles for Inter-service, Interdepartmental and Interagency Support, 27 March 1972.

W-115. DODD 4100.15, Commercial or Industrial Activities, 3 July 1971.

W-116. DODI 4100.33, Commercial or Industrial Activities - Operation of, 16 July 1971.

W-117. DODD 4151.1, Use of Contractor and Government Resources for Maintenance of Materiel, 20 June 1970.

W-118. DODI 4151.15, Depot Maintenance Support Programming Policies, 24 June 1969.

W-119. DODI 4151.16, DOD Equipment Maintenance Program, 30 August 1972.

W-120. DODD 5410.12, Policies and Procedures for Minimizing Economic Impact on Communities Resulting from Adjustments in Defense Programs, 20 October 1961.

W-121. DODI 7220.29, Uniform Depot Maintenance Cost Accounting and Production Reporting System, 28 October 1968.

W-122. DODD 7410.4, Regulations Governing Industrial Fund Operations, 25 September 1972.

W-123. OMB Circular No. A-76, Policies for Acquiring Commercial or Industrial Products and Services for Government Use, 20 August 1967.

W-124. DODI 5000.3, Test & Evaluation, 19 January 1973.

W-125. Letter of Instruction for Implementing the New Acquisition Policies, 23 August 1972.

W-126. U. S. Army Regulation, Operational Test and Evaluation Agency (Organization and Functions), AR 10-4.

W-127. U. S. Army Regulation, Department of the Army, (Organization and Functions), AR 10-5.

W-128. U. S. Army Regulation, Ar y Materiel Command, (Organization and Functions), AR-10-11.

W-129. U. S. Army Regulation, The Management Process for Development of Army Systems, AR-11-25.

W-130. U. S. Army Regulation, Systems Acquisition Review Council Procedures, AR 15-14.

W-131. U. S. Army Regulation, Army Combat Developments, AR 71-1.

W-132. U. S. Army Regulation, User Field Tests (Draft), AR 71-3.

W-133. U. S. Army Regulation, The Army Program for Test and Evaluation, AT 71-8.

W-134. U. S. Army Regulation, Army Research and Development, AR 70-1.

W-135. U. S. Army Regulation, Army Materiel Reliability, Availability, Maintainability, AR 702-3.

W-136. Department of the Army Pamphlet, Life Cycle Management Model for Army Systems. (Draft), DA PAM 11-25.

W-137. U. S. Army Regulation, Development Plan/Development Concept Paper/Program Memorandum, AR 70-27.

W-138. U. S. Army Regulation, Basis of Issue Plans, AR 71-2.

W-139. U. S Army Regulation, Type Classification/Reclassification of Army Materiel, AR 71-6.

W-140. GAO Draft/Letter/Report, Testing and Evaluation Policies and Practices, (OSD Case 3739), 20 November 1973.

W-141. GAO Report, The Importance of Testing and Evaluation in the Acquisition Process for Major Weapon Systems, (B163058), 7 August 1972.

W-142. Chief of Staff Memorandum, Executive Secretary of the Army Systems Acquisition Review Council, CSM 72-15-219, 6 October 1972.

W-143. U. S. Department of Defense, Armed Services Procurement Regulation 1-2013, 1405, & F 200.1539 (NASA PR 1.400); The Appointment of Contracting Officers.

W-144. U. S. Department of Defense, Armed Services Procurement Regulation 7-600, 15-400 (NASA PR 4.200 & 15.400), Construction & Architect-Engineer Services.

W-145. DODD 4105.63 (MILSCAP); Military Standard Contract Administration Procedures.
also (MILSTRIP) Military Standard Requisitioning & Issue Procedures
also (MILSTRAP) Military Standard Reporting & Acquisition Procedures
also (MILSTEP) Military Supply & Transportation Evaluation Procedures

W-146. DODD 4000.19, Basic Policies & Principles for Interservice Interdepartmental, and Interagency Support, March 1972.

W-147. U. S. Army Regulation, United States Army Training and Doctrine Command, (Organization and Functions), AR 10-41.

W-148. U. S. Army Regulation, United States Army Forces Command, (Organization and Functions), AR 10-42.

W-149. U. S. Army Regulation, Dictionary of United States Army Terms, AR 310-25.

W-150. U. S. Army Regulation, Authorized Abbreviations and Brevity Codes, AR 310-50.

W-151. Department of the Army Pamphlet, Life Cycle Management Model for Army Systems, PAM 11-25.